

GPS, Assisted GPS, GPS P-Code, Galileo, GNSS, GLONASS Digital Standard for R&S[®]SMBV and R&S[®]WinIQSIM2 Operating Manual



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This document describes the following software options:

- R&S®SMBV-K44/K244/K65/K266/K66/K91/K92/K93/K94/K294/K96
1415.8060.xx, 1415.8260.02, 1415.8560.xx, 1415.8590.02, 1415.8683.xx, 1415.8577.xx, 1415.8583.xx,
1415.8660.xx, 1415.8677.xx, 1415.8690.02, 1415.8790.xx
- R&S®SMU-K244/K266/K294
1408.5818.02, 1408.8630.02, 1408.8617.02
- R&S®SMJ-K244/K266/K294
1409.0810.02, 1409.3502.02, 1409.3483.02
- R&S®AMU-K244/K266/K294
1402.7902.02, 1403.0976.02, 1403.0953.02
- R&S®AFQ-K244/K266/K294
1401.6454.02, 1415.0330.02, 1415.0318.02
- R&S®SFU-K244
2115.2250.02

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Subject to change – Data without tolerance limits is not binding.

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The following abbreviations are used throughout this manual: R&S®SMBV is abbreviated as R&S SMBV, R&S®WinIQSIM2 is abbreviated as R&S WinIQSIM2

Basic Safety Instructions

Always read through and comply with the following safety instructions!




All plants and locations of the Rohde & Schwarz group of companies make every effort to keep the safety standards of our products up to date and to offer our customers the highest possible degree of safety. Our products and the auxiliary equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. Compliance with these standards is continuously monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions, the Rohde & Schwarz group of companies will be happy to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for use solely in industrial and laboratory environments or, if expressly permitted, also in the field and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any purpose other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and, in some cases, a basic knowledge of English. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills be allowed to use the product. If personal safety gear is required for using Rohde & Schwarz products, this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation. In these safety instructions, the word "product" refers to all merchandise sold and distributed by the Rohde & Schwarz group of companies, including instruments, systems and all accessories. For product-specific information, see the data sheet and the product documentation.

Symbols and safety labels

Symbol	Meaning	Symbol	Meaning
	Notice, general danger location Observe product documentation	○	ON/OFF supply voltage
	Caution when handling heavy equipment	⏻	Standby indication
	Danger of electric shock	— — —	Direct current (DC)

Basic Safety Instructions

Symbol	Meaning	Symbol	Meaning
	Warning! Hot surface		Alternating current (AC)
	Protective conductor terminal		Direct/alternating current (DC/AC)
	Ground		Device fully protected by double (reinforced) insulation
	Ground terminal		EU labeling for batteries and accumulators For additional information, see section "Waste disposal/Environmental protection", item 1.
	Be careful when handling electrostatic sensitive devices		EU labeling for separate collection of electrical and electronic devices For additional information, see section "Waste disposal/Environmental protection", item 2.
	Warning! Laser radiation For additional information, see section "Operation", item 7.		

Signal words and their meaning

The following signal words are used in the product documentation in order to warn the reader about risks and dangers.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



Indicates the possibility of incorrect operation which can result in damage to the product.

In the product documentation, the word ATTENTION is used synonymously.

These signal words are in accordance with the standard definition for civil applications in the European Economic Area. Definitions that deviate from the standard definition may also exist in other economic areas or military applications. It is therefore essential to make sure that the signal words described here are always used only in connection with the related product documentation and the related product. The use of signal words in connection with unrelated products or documentation can result in misinterpretation and in personal injury or material damage.

Basic Safety Instructions

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer, without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

1. Unless otherwise specified, the following requirements apply to Rohde & Schwarz products: predefined operating position is always with the housing floor facing down, IP protection 2X, use only indoors, max. operating altitude 2000 m above sea level, max. transport altitude 4500 m above sea level. A tolerance of $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ to the nominal frequency, overvoltage category 2, pollution severity 2.
2. Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or even death.
3. Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or even death.

Electrical safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

1. Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If a different voltage is to be set, the power fuse of the product may have to be changed accordingly.
2. In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with a protective conductor contact and protective conductor.
3. Intentionally breaking the protective conductor either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
4. If there is no power switch for disconnecting the product from the AC supply network, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the AC supply network. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.
5. Never use the product if the power cable is damaged. Check the power cables on a regular basis to ensure that they are in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, ensure that the cable cannot be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.

Basic Safety Instructions

6. The product may be operated only from TN/TT supply networks fuse-protected with max. 16 A (higher fuse only after consulting with the Rohde & Schwarz group of companies).
7. Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket provided for this purpose. Otherwise, sparks that result in fire and/or injuries may occur.
8. Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.
9. For measurements in circuits with voltages $V_{rms} > 30$ V, suitable measures (e.g. appropriate measuring equipment, fuse protection, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
10. Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1/EN60950-1 or IEC61010-1/EN 61010-1 standards that apply in each case.
11. Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
12. If a product is to be permanently installed, the connection between the protective conductor terminal on site and the product's protective conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
13. For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fuse-protected in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
14. Use suitable overvoltage protection to ensure that no overvoltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
15. Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
16. Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1). Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
17. Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.
18. Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol, acetone or diluents for cellulose lacquers.

Operation

1. Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.

Basic Safety Instructions

2. Before you move or transport the product, read and observe the section titled "Transport".
3. As with all industrially manufactured goods, the use of substances that induce an allergic reaction (allergens) such as nickel cannot be generally excluded. If you develop an allergic reaction (such as a skin rash, frequent sneezing, red eyes or respiratory difficulties) when using a Rohde & Schwarz product, consult a physician immediately to determine the cause and to prevent health problems or stress.
4. Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal/Environmental protection", item 1.
5. Depending on the function, certain products such as RF radio equipment can produce an elevated level of electromagnetic radiation. Considering that unborn babies require increased protection, pregnant women must be protected by appropriate measures. Persons with pacemakers may also be exposed to risks from electromagnetic radiation. The employer/operator must evaluate workplaces where there is a special risk of exposure to radiation and, if necessary, take measures to avert the potential danger.
6. Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.
7. Laser products are given warning labels that are standardized according to their laser class. Lasers can cause biological harm due to the properties of their radiation and due to their extremely concentrated electromagnetic power. If a laser product (e.g. a CD/DVD drive) is integrated into a Rohde & Schwarz product, absolutely no other settings or functions may be used as described in the product documentation. The objective is to prevent personal injury (e.g. due to laser beams).
8. EMC classes (in line with CISPR 11)
Class A: Equipment suitable for use in all environments except residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings.
Class B: Equipment suitable for use in residential environments and environments that are directly connected to a low-voltage supply network that supplies residential buildings.

Repair and service

1. The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
2. Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rohde & Schwarz. Only original parts may be used for replacing parts relevant to safety (e.g. power switches, power transformers, fuses). A safety test must always be performed after parts relevant to safety have been replaced (visual inspection, protective conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Basic Safety Instructions

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e.g. lithium cells) must be handled in accordance with the EN 62133 standard.

1. Cells must not be taken apart or crushed.
2. Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
3. Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
4. Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
5. If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
6. Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rohde & Schwarz type (see parts list) in order to ensure the safety of the product.
7. Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

1. The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
2. Handles on the products are designed exclusively to enable personnel to transport the product. It is therefore not permissible to use handles to fasten the product to or on transport equipment such as cranes, fork lifts, wagons, etc. The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Noncompliance can result in personal injury or material damage.
3. If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.

Waste disposal/Environmental protection

1. Specially marked equipment has a battery or accumulator that must not be disposed of with unsorted municipal waste, but must be collected separately. It may only be disposed of at a suitable collection point or via a Rohde & Schwarz customer service center.

Instrucciones de seguridad elementales

2. Waste electrical and electronic equipment must not be disposed of with unsorted municipal waste, but must be collected separately.
Rohde & Schwarz GmbH & Co. KG has developed a disposal concept and takes full responsibility for take-back obligations and disposal obligations for manufacturers within the EU. Contact your Rohde & Schwarz customer service center for environmentally responsible disposal of the product.
3. If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
4. If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

For additional information about environmental protection, visit the Rohde & Schwarz website.

Instrucciones de seguridad elementales

¡Es imprescindible leer y cumplir las siguientes instrucciones e informaciones de seguridad!

El principio del grupo de empresas Rohde & Schwarz consiste en tener nuestros productos siempre al día con los estándares de seguridad y de ofrecer a nuestros clientes el máximo grado de seguridad. Nuestros productos y todos los equipos adicionales son siempre fabricados y examinados según las normas de seguridad vigentes. Nuestro sistema de garantía de calidad controla constantemente que sean cumplidas estas normas. El presente producto ha sido fabricado y examinado según el certificado de conformidad adjunto de la UE y ha salido de nuestra planta en estado impecable según los estándares técnicos de seguridad. Para poder preservar este estado y garantizar un funcionamiento libre de peligros, el usuario deberá atenerse a todas las indicaciones, informaciones de seguridad y notas de alerta. El grupo de empresas Rohde & Schwarz está siempre a su disposición en caso de que tengan preguntas referentes a estas informaciones de seguridad.














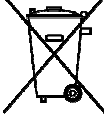
Además queda en la responsabilidad del usuario utilizar el producto en la forma debida. Este producto está destinado exclusivamente al uso en la industria y el laboratorio o, si ha sido expresamente autorizado, para aplicaciones de campo y de ninguna manera deberá ser utilizado de modo que alguna persona/cosa pueda sufrir daño. El uso del producto fuera de sus fines definidos o sin tener en cuenta las instrucciones del fabricante queda en la responsabilidad del usuario. El fabricante no se hace en ninguna forma responsable de consecuencias a causa del mal uso del producto.

Instrucciones de seguridad elementales


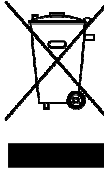

Se parte del uso correcto del producto para los fines definidos si el producto es utilizado conforme a las indicaciones de la correspondiente documentación del producto y dentro del margen de rendimiento definido (ver hoja de datos, documentación, informaciones de seguridad que siguen). El uso del producto hace necesarios conocimientos técnicos y ciertos conocimientos del idioma inglés. Por eso se debe tener en cuenta que el producto solo pueda ser operado por personal especializado o personas instruidas en profundidad con las capacidades correspondientes. Si fuera necesaria indumentaria de seguridad para el uso de productos de Rohde & Schwarz, encontraría la información debida en la documentación del producto en el capítulo correspondiente. Guarde bien las informaciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

Tener en cuenta las informaciones de seguridad sirve para evitar en lo posible lesiones o daños por peligros de toda clase. Por eso es imprescindible leer detalladamente y comprender por completo las siguientes informaciones de seguridad antes de usar el producto, y respetarlas durante el uso del producto. Deberán tenerse en cuenta todas las demás informaciones de seguridad, como p. ej. las referentes a la protección de personas, que encontrarán en el capítulo correspondiente de la documentación del producto y que también son de obligado cumplimiento. En las presentes informaciones de seguridad se recogen todos los objetos que distribuye el grupo de empresas Rohde & Schwarz bajo la denominación de "producto", entre ellos también aparatos, instalaciones así como toda clase de accesorios. Los datos específicos del producto figuran en la hoja de datos y en la documentación del producto.

Símbolos y definiciones de seguridad

Símbolo	Significado	Símbolo	Significado
	Aviso: punto de peligro general Observar la documentación del producto		Tensión de alimentación de PUESTA EN MARCHA / PARADA
	Atención en el manejo de dispositivos de peso elevado		Indicación de estado de espera (standby)
	Peligro de choque eléctrico		Corriente continua (DC)
	Advertencia: superficie caliente		Corriente alterna (AC)
	Conexión a conductor de protección		Corriente continua / Corriente alterna (DC/AC)
	Conexión a tierra		El aparato está protegido en su totalidad por un aislamiento doble (reforzado)
	Conexión a masa		Distintivo de la UE para baterías y acumuladores Más información en la sección "Eliminación/protección del medio ambiente", punto 1.

Instrucciones de seguridad elementales

Símbolo	Significado	Símbolo	Significado
	Aviso: Cuidado en el manejo de dispositivos sensibles a la electrostática (ESD)		Distintivo de la UE para la eliminación por separado de dispositivos eléctricos y electrónicos Más información en la sección "Eliminación/protección del medio ambiente", punto 2.
	Advertencia: rayo láser Más información en la sección "Funcionamiento", punto 7.		

Palabras de señal y su significado

En la documentación del producto se utilizan las siguientes palabras de señal con el fin de advertir contra riesgos y peligros.



PELIGRO identifica un peligro inminente con riesgo elevado que provocará muerte o lesiones graves si no se evita.



ADVERTENCIA identifica un posible peligro con riesgo medio de provocar muerte o lesiones (graves) si no se evita.



ATENCIÓN identifica un peligro con riesgo reducido de provocar lesiones leves o moderadas si no se evita.



AVISO indica la posibilidad de utilizar mal el producto y, como consecuencia, dañarlo.
En la documentación del producto se emplea de forma sinónima el término CUIDADO.

Las palabras de señal corresponden a la definición habitual para aplicaciones civiles en el área económica europea. Pueden existir definiciones diferentes a esta definición en otras áreas económicas o en aplicaciones militares. Por eso se deberá tener en cuenta que las palabras de señal aquí descritas sean utilizadas siempre solamente en combinación con la correspondiente documentación del producto y solamente en combinación con el producto correspondiente. La utilización de las palabras de señal en combinación con productos o documentaciones que no les correspondan puede llevar a interpretaciones equivocadas y tener por consecuencia daños en personas u objetos.

Estados operativos y posiciones de funcionamiento

El producto solamente debe ser utilizado según lo indicado por el fabricante respecto a los estados operativos y posiciones de funcionamiento sin que se obstruya la ventilación. Si no se siguen las indicaciones del fabricante, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte. En todos los trabajos deberán ser tenidas en cuenta las normas nacionales y locales de seguridad del trabajo y de prevención de accidentes.

Instrucciones de seguridad elementales

1. Si no se convino de otra manera, es para los productos Rohde & Schwarz válido lo que sigue: como posición de funcionamiento se define por principio la posición con el suelo de la caja para abajo, modo de protección IP 2X, uso solamente en estancias interiores, utilización hasta 2000 m sobre el nivel del mar, transporte hasta 4500 m sobre el nivel del mar. Se aplicará una tolerancia de $\pm 10\%$ sobre el voltaje nominal y de $\pm 5\%$ sobre la frecuencia nominal. Categoría de sobrecarga eléctrica 2, índice de suciedad 2.
2. No sitúe el producto encima de superficies, vehículos, estantes o mesas, que por sus características de peso o de estabilidad no sean aptos para él. Siga siempre las instrucciones de instalación del fabricante cuando instale y asegure el producto en objetos o estructuras (p. ej. paredes y estantes). Si se realiza la instalación de modo distinto al indicado en la documentación del producto, se pueden causar lesiones o, en determinadas circunstancias, incluso la muerte.
3. No ponga el producto sobre aparatos que generen calor (p. ej. radiadores o calefactores). La temperatura ambiente no debe superar la temperatura máxima especificada en la documentación del producto o en la hoja de datos. En caso de sobrecalentamiento del producto, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

Seguridad eléctrica

Si no se siguen (o se siguen de modo insuficiente) las indicaciones del fabricante en cuanto a seguridad eléctrica, pueden producirse choques eléctricos, incendios y/o lesiones graves con posible consecuencia de muerte.

1. Antes de la puesta en marcha del producto se deberá comprobar siempre que la tensión preseleccionada en el producto coincida con la de la red de alimentación eléctrica. Si es necesario modificar el ajuste de tensión, también se deberán cambiar en caso dado los fusibles correspondientes del producto.
2. Los productos de la clase de protección I con alimentación móvil y enchufe individual solamente podrán enchufarse a tomas de corriente con contacto de seguridad y con conductor de protección conectado.
3. Queda prohibida la interrupción intencionada del conductor de protección, tanto en la toma de corriente como en el mismo producto. La interrupción puede tener como consecuencia el riesgo de que el producto sea fuente de choques eléctricos. Si se utilizan cables alargadores o regletas de enchufe, deberá garantizarse la realización de un examen regular de los mismos en cuanto a su estado técnico de seguridad.
4. Si el producto no está equipado con un interruptor para desconectarlo de la red, o bien si el interruptor existente no resulta apropiado para la desconexión de la red, el enchufe del cable de conexión se deberá considerar como un dispositivo de desconexión. El dispositivo de desconexión se debe poder alcanzar fácilmente y debe estar siempre bien accesible. Si, p. ej., el enchufe de conexión a la red es el dispositivo de desconexión, la longitud del cable de conexión no debe superar 3 m). Los interruptores selectores o electrónicos no son aptos para el corte de la red eléctrica. Si se integran productos sin interruptor en bastidores o instalaciones, se deberá colocar el interruptor en el nivel de la instalación.
5. No utilice nunca el producto si está dañado el cable de conexión a red. Compruebe regularmente el correcto estado de los cables de conexión a red. Asegúrese, mediante las medidas de protección y de instalación adecuadas, de que el cable de conexión a red no pueda ser dañado o de que nadie pueda ser dañado por él, p. ej. al tropezar o por un choque eléctrico.

Instrucciones de seguridad elementales

6. Solamente está permitido el funcionamiento en redes de alimentación TN/TT aseguradas con fusibles de 16 A como máximo (utilización de fusibles de mayor amperaje solo previa consulta con el grupo de empresas Rohde & Schwarz).
7. Nunca conecte el enchufe en tomas de corriente sucias o llenas de polvo. Introduzca el enchufe por completo y fuertemente en la toma de corriente. La no observación de estas medidas puede provocar chispas, fuego y/o lesiones.
8. No sobrecargue las tomas de corriente, los cables alargadores o las regletas de enchufe ya que esto podría causar fuego o choques eléctricos.
9. En las mediciones en circuitos de corriente con una tensión $U_{\text{eff}} > 30 \text{ V}$ se deberán tomar las medidas apropiadas para impedir cualquier peligro (p. ej. medios de medición adecuados, seguros, limitación de tensión, corte protector, aislamiento etc.).
10. Para la conexión con dispositivos informáticos como un PC o un ordenador industrial, debe comprobarse que éstos cumplan los estándares IEC60950-1/EN60950-1 o IEC61010-1/EN 61010-1 válidos en cada caso.
11. A menos que esté permitido expresamente, no retire nunca la tapa ni componentes de la carcasa mientras el producto esté en servicio. Esto pone a descubierto los cables y componentes eléctricos y puede causar lesiones, fuego o daños en el producto.
12. Si un producto se instala en un lugar fijo, se deberá primero conectar el conductor de protección fijo con el conductor de protección del producto antes de hacer cualquier otra conexión. La instalación y la conexión deberán ser efectuadas por un electricista especializado.
13. En el caso de dispositivos fijos que no estén provistos de fusibles, interruptor automático ni otros mecanismos de seguridad similares, el circuito de alimentación debe estar protegido de modo que todas las personas que puedan acceder al producto, así como el producto mismo, estén a salvo de posibles daños.
14. Todo producto debe estar protegido contra sobretensión (debida p. ej. a una caída del rayo) mediante los correspondientes sistemas de protección. Si no, el personal que lo utilice quedará expuesto al peligro de choque eléctrico.
15. No debe introducirse en los orificios de la caja del aparato ningún objeto que no esté destinado a ello. Esto puede producir cortocircuitos en el producto y/o puede causar choques eléctricos, fuego o lesiones.
16. Salvo indicación contraria, los productos no están impermeabilizados (ver también el capítulo "Estados operativos y posiciones de funcionamiento", punto 1). Por eso es necesario tomar las medidas necesarias para evitar la entrada de líquidos. En caso contrario, existe peligro de choque eléctrico para el usuario o de daños en el producto, que también pueden redundar en peligro para las personas.
17. No utilice el producto en condiciones en las que pueda producirse o ya se hayan producido condensaciones sobre el producto o en el interior de éste, como p. ej. al desplazarlo de un lugar frío a otro caliente. La entrada de agua aumenta el riesgo de choque eléctrico.
18. Antes de la limpieza, desconecte por completo el producto de la alimentación de tensión (p. ej. red de alimentación o batería). Realice la limpieza de los aparatos con un paño suave, que no se deshilache. No utilice bajo ningún concepto productos de limpieza químicos como alcohol, acetona o diluyentes para lacas nitrocelulósicas.

Instrucciones de seguridad elementales

Funcionamiento

1. El uso del producto requiere instrucciones especiales y una alta concentración durante el manejo. Debe asegurarse que las personas que manejen el producto estén a la altura de los requerimientos necesarios en cuanto a aptitudes físicas, psíquicas y emocionales, ya que de otra manera no se pueden excluir lesiones o daños de objetos. El empresario u operador es responsable de seleccionar el personal usuario apto para el manejo del producto.
2. Antes de desplazar o transportar el producto, lea y tenga en cuenta el capítulo "Transporte".
3. Como con todo producto de fabricación industrial no puede quedar excluida en general la posibilidad de que se produzcan alergias provocadas por algunos materiales empleados —los llamados alérgenos (p. ej. el níquel)—. Si durante el manejo de productos Rohde & Schwarz se producen reacciones alérgicas, como p. ej. irritaciones cutáneas, estornudos continuos, enrojecimiento de la conjuntiva o dificultades respiratorias, debe avisarse inmediatamente a un médico para investigar las causas y evitar cualquier molestia o daño a la salud.
4. Antes de la manipulación mecánica y/o térmica o el desmontaje del producto, debe tenerse en cuenta imprescindiblemente el capítulo "Eliminación/protección del medio ambiente", punto 1.
5. Ciertos productos, como p. ej. las instalaciones de radiocomunicación RF, pueden a causa de su función natural, emitir una radiación electromagnética aumentada. Deben tomarse todas las medidas necesarias para la protección de las mujeres embarazadas. También las personas con marcapasos pueden correr peligro a causa de la radiación electromagnética. El empresario/operador tiene la obligación de evaluar y señalizar las áreas de trabajo en las que exista un riesgo elevado de exposición a radiaciones.
6. Tenga en cuenta que en caso de incendio pueden desprenderse del producto sustancias tóxicas (gases, líquidos etc.) que pueden generar daños a la salud. Por eso, en caso de incendio deben usarse medidas adecuadas, como p. ej. máscaras antigás e indumentaria de protección.
7. Los productos con láser están provistos de indicaciones de advertencia normalizadas en función de la clase de láser del que se trate. Los rayos láser pueden provocar daños de tipo biológico a causa de las propiedades de su radiación y debido a su concentración extrema de potencia electromagnética. En caso de que un producto Rohde & Schwarz contenga un producto láser (p. ej. un lector de CD/DVD), no debe usarse ninguna otra configuración o función aparte de las descritas en la documentación del producto, a fin de evitar lesiones (p. ej. debidas a irradiación láser).
8. Clases CEM (según CISPR 11)
Clase A: dispositivo apropiado para el uso en cualquier zona excepto en áreas residenciales y en aquellas zonas que se encuentran conectadas a una red de suministro de baja tensión que alimenta un edificio de viviendas.
Clase B: dispositivo apropiado para el uso en áreas residenciales y en aquellas zonas que se encuentran conectadas a una red de suministro de baja tensión que alimenta un edificio de viviendas.

Reparación y mantenimiento

1. El producto solamente debe ser abierto por personal especializado con autorización para ello. Antes de manipular el producto o abrirlo, es obligatorio desconectarlo de la tensión de alimentación, para evitar toda posibilidad de choque eléctrico.

Instrucciones de seguridad elementales

2. El ajuste, el cambio de partes, el mantenimiento y la reparación deberán ser efectuadas solamente por electricistas autorizados por Rohde & Schwarz. Si se reponen partes con importancia para los aspectos de seguridad (p. ej. el enchufe, los transformadores o los fusibles), solamente podrán ser sustituidos por partes originales. Después de cada cambio de partes relevantes para la seguridad deberá realizarse un control de seguridad (control a primera vista, control del conductor de protección, medición de resistencia de aislamiento, medición de la corriente de fuga, control de funcionamiento). Con esto queda garantizada la seguridad del producto.

Baterías y acumuladores o celdas

Si no se siguen (o se siguen de modo insuficiente) las indicaciones en cuanto a las baterías y acumuladores o celdas, pueden producirse explosiones, incendios y/o lesiones graves con posible consecuencia de muerte. El manejo de baterías y acumuladores con electrolitos alcalinos (p. ej. celdas de litio) debe seguir el estándar EN 62133.

1. No deben desmontarse, abrirse ni triturarse las celdas.
2. Las celdas o baterías no deben someterse a calor ni fuego. Debe evitarse el almacenamiento a la luz directa del sol. Las celdas y baterías deben mantenerse limpias y secas. Limpiar las conexiones sucias con un paño seco y limpio.
3. Las celdas o baterías no deben cortocircuitarse. Es peligroso almacenar las celdas o baterías en estuches o cajones en cuyo interior puedan cortocircuitarse por contacto recíproco o por contacto con otros materiales conductores. No deben extraerse las celdas o baterías de sus embalajes originales hasta el momento en que vayan a utilizarse.
4. Las celdas o baterías no deben someterse a impactos mecánicos fuertes indebidos.
5. En caso de falta de estanqueidad de una celda, el líquido vertido no debe entrar en contacto con la piel ni los ojos. Si se produce contacto, lavar con agua abundante la zona afectada y avisar a un médico.
6. En caso de cambio o recarga inadecuados, las celdas o baterías que contienen electrolitos alcalinos (p. ej. las celdas de litio) pueden explotar. Para garantizar la seguridad del producto, las celdas o baterías solo deben ser sustituidas por el tipo Rohde & Schwarz correspondiente (ver lista de recambios).
7. Las baterías y celdas deben reciclarse y no deben tirarse a la basura doméstica. Las baterías o acumuladores que contienen plomo, mercurio o cadmio deben tratarse como residuos especiales. Respete en esta relación las normas nacionales de eliminación y reciclaje.

Transporte

1. El producto puede tener un peso elevado. Por eso es necesario desplazarlo o transportarlo con precaución y, si es necesario, usando un sistema de elevación adecuado (p. ej. una carretilla elevadora), a fin de evitar lesiones en la espalda u otros daños personales.
2. Las asas instaladas en los productos sirven solamente de ayuda para el transporte del producto por personas. Por eso no está permitido utilizar las asas para la sujeción en o sobre medios de transporte como p. ej. grúas, carretillas elevadoras de horquilla, carros etc. Es responsabilidad suya fijar los productos de manera segura a los medios de transporte o elevación. Para evitar daños personales o daños en el producto, siga las instrucciones de seguridad del fabricante del medio de transporte o elevación utilizado.

Instrucciones de seguridad elementales

3. Si se utiliza el producto dentro de un vehículo, recae de manera exclusiva en el conductor la responsabilidad de conducir el vehículo de manera segura y adecuada. El fabricante no asumirá ninguna responsabilidad por accidentes o colisiones. No utilice nunca el producto dentro de un vehículo en movimiento si esto pudiera distraer al conductor. Asegure el producto dentro del vehículo debidamente para evitar, en caso de un accidente, lesiones u otra clase de daños.

Eliminación/protección del medio ambiente

1. Los dispositivos marcados contienen una batería o un acumulador que no se debe desechar con los residuos domésticos sin clasificar, sino que debe ser recogido por separado. La eliminación se debe efectuar exclusivamente a través de un punto de recogida apropiado o del servicio de atención al cliente de Rohde & Schwarz.
2. Los dispositivos eléctricos usados no se deben desechar con los residuos domésticos sin clasificar, sino que deben ser recogidos por separado.
Rohde & Schwarz GmbH & Co.KG ha elaborado un concepto de eliminación de residuos y asume plenamente los deberes de recogida y eliminación para los fabricantes dentro de la UE. Para desechar el producto de manera respetuosa con el medio ambiente, diríjase a su servicio de atención al cliente de Rohde & Schwarz.
3. Si se trabaja de manera mecánica y/o térmica cualquier producto o componente más allá del funcionamiento previsto, pueden liberarse sustancias peligrosas (polvos con contenido de metales pesados como p. ej. plomo, berilio o níquel). Por eso el producto solo debe ser desmontado por personal especializado con formación adecuada. Un desmontaje inadecuado puede ocasionar daños para la salud. Se deben tener en cuenta las directivas nacionales referentes a la eliminación de residuos.
4. En caso de que durante el trato del producto se formen sustancias peligrosas o combustibles que deban tratarse como residuos especiales (p. ej. refrigerantes o aceites de motor con intervalos de cambio definidos), deben tenerse en cuenta las indicaciones de seguridad del fabricante de dichas sustancias y las normas regionales de eliminación de residuos. Tenga en cuenta también en caso necesario las indicaciones de seguridad especiales contenidas en la documentación del producto. La eliminación incorrecta de sustancias peligrosas o combustibles puede causar daños a la salud o daños al medio ambiente.

Se puede encontrar más información sobre la protección del medio ambiente en la página web de Rohde & Schwarz.

Qualitätszertifikat

Certificate of quality

Certificat de qualité

Certified Quality System
ISO 9001

Certified Environmental System
ISO 14001

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde&Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde&Schwarz-Qualitätsmanagementsystem ist u.a. nach ISO9001 und ISO14001 zertifiziert.

Der Umwelt verpflichtet

- ▮ Energie-effiziente, RoHS-konforme Produkte
- ▮ Kontinuierliche Weiterentwicklung nachhaltiger Umweltkonzepte
- ▮ ISO 14001-zertifiziertes Umweltmanagementsystem

Dear Customer,

You have decided to buy a Rohde&Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards. The Rohde&Schwarz quality management system is certified according to standards such as ISO9001 and ISO14001.

Environmental commitment

- ▮ Energy-efficient products
- ▮ Continuous improvement in environmental sustainability
- ▮ ISO 14001-certified environmental management system

Cher client,

Vous avez choisi d'acheter un produit Rohde&Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité. Le système de gestion qualité de Rohde&Schwarz a été homologué, entre autres, conformément aux normes ISO9001 et ISO14001.

Engagement écologique

- ▮ Produits à efficience énergétique
- ▮ Amélioration continue de la durabilité environnementale
- ▮ Système de gestion de l'environnement certifié selon ISO 14001

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish. We will take care that you will get the right information.

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1 Preface

1.1 Documentation Overview

The user documentation for the R&S SMBV consists of the following parts:

- Online Help system on the instrument,
- "Quick Start Guide" printed manual,
- Documentation CD-ROM with:
 - Online help system (*.chm) as a standalone help,
 - Operating Manuals for base unit and options,
 - Service Manual,
 - Data sheet and specifications,
 - Links to useful sites on the R&S internet.

Online Help

The Online Help is embedded in the instrument's firmware. It offers quick, context-sensitive access to the complete information needed for operation and programming. The online help contains help on operating the R&S SMBV and all available options.

Quick Start Guide

The Quick Start Guide is delivered with the instrument in printed form and in PDF format on the Documentation CD-ROM. It provides the information needed to set up and start working with the instrument. Basic operations and an example of setup are described. The manual includes also general information, e.g., Safety Instructions.

Operating Manuals

The Operating Manuals are a supplement to the Quick Start Guide. Operating Manuals are provided for the base unit and each additional (software) option.

These manuals are available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. In the Operating Manual for the base unit, all instrument functions are described in detail. Furthermore, it provides an introduction to remote control and a complete description of the remote control commands with programming examples. Information on maintenance, instrument interfaces and error messages is also given.

In the individual option manuals, the specific instrument functions of the option are described in detail. For additional information on default settings and parameters, refer to the data sheets. Basic information on operating the R&S SMBV is not included in the option manuals.

These manuals can also be ordered in printed form (see ordering information in the data sheet).

Service Manual

The Service Manual is available in PDF format - in printable form - on the Documentation CD-ROM delivered with the instrument. It describes how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the instrument by the replacement of modules.

This manual can also be orderd in printed form (see ordering information in the data sheet).

Release Notes

The release notes describe new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided in the Internet.

1.2 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
KEYS	Key names are written in capital letters.
File names, commands, program code	File names, commands, coding samples and screen output are distinguished by their font.
<i>Input</i>	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

2 General Description

The global navigation satellite system (GNSS) employs the radio signals of several navigation standards, like GPS, Galileo, GLONASS, etc. For several years, GPS used to be the only standard available for civilian navigation through its C/A civilian code. Nowadays, the GNSS signals and systems are undergoing fast development, some systems are getting modernized and some are completely new. In the foreseeable future/In the near future/In the next years, several more GNSS satellites utilizing more and new frequency will be available for civilian and military use.

The GNSS implementation in the R&S SMBV provides you with the ability to generate the signal of up to 6, 12 or 24 GNSS satellites, depending on the installed options. Signal generation is done in real-time and thus it is not limited to a certain time period.

The GNSS implementation in the R&S WINIQSIM2 allows you to generate waveform files that can be loaded to an R&S Vector Signal Generator, e.g. the R&S SMU200A. It provides you the ability to generate the signal of one GPS, Galileo or Glonass satellite on either an R&S SMU200A, R&S SMJ100A, R&S AMU200A, R&S AFQ100A or R&S SMBV100A. Depending on the availability of the respective options, e.g. R&S SMU-K244/-K266/-K294 you can simulate **one** GPS, Galileo or GLONASS satellite respectively on the generator.

As a major difference to the real-time solution, the satellite signal is limited to a certain time period depending on the ARB capacity of the vector signal generator and the user configurable sample rate of the satellite signal.

Brief introduction to the GNSS standards

- **GPS**

The Global Positioning System (GPS) consists of several satellites circling the earth in low orbits. The satellites transmit permanently information that can be used by the receivers to calculate their current position (ephemeris) and about the orbits of all satellites (almanac). The 3D position of a receiver on the earth can be determined by carrying out delay measurements of at least four signals emitted by different satellites. Being transmitted on a single carrier frequency, the signals of the individual satellites can be distinguished by means of correlation (Gold) codes. These ranging codes are used as spreading code for the navigation message which is transmitted at a rate of 50 baud.

- **Assisted GPS (A-GPS)**

Assisted GPS (A-GPS) was introduced to different mobile communication standards to significantly reduce the Time To First Fix (TTFF) of a user equipment (UE) containing a GPS receiver. This is achieved by transmitting information about the satellites directly from the base station to the UE.

Depending on previous knowledge, a stand-alone GPS receiver needs about 30-60 seconds for a first fix and up to 12.5 minutes to get all information (almanac).

In A-GPS "UE based mode", the base station assists the UE by providing the complete navigation message along with a list of visible satellites and ephemeris data. In addition to this information, the UE gets the location and the current time at the Base Station and that speeds up both acquisition and navigation processes of the GPS receiver and hence reduces TTFF to a few seconds.

Functional Overview of the Basic Realtime GNSS Options GPS, Galileo and GLONASS

In A-GPS "UE assisted mode", the base station is even responsible for the calculation of the UE's exact location, i.e. the base station performs the navigation based on the raw measurements provided by the UE. Since the Acquisition Assistance Data provided by the Base Station already serves speeding up the acquisition process, the UE only has to track the code and carrier phase.

- **Galileo**

Galileo is the European global navigation satellite system that provides global positioning service under civilian control. It is planned to be inter-operable with GPS and GLONASS and other global satellite navigation systems.

The fully deployed Galileo system consists of 30 satellites (27 operational and 3 spares). Three independent CDMA signals, named E5, E6 and E1, are permanently transmitted by all Galileo satellites. The E5 signal is further sub-divided into two signals denoted E5a and E5b (see [figure 2-1](#)).

- **GLONASS**

Glonass is the russian global navigation satellite system. It is expected to be fully operational before the end of 2011 with 24 Modernized Glonass Satellites touring the globe. Together with GPS, up to 54 GNSS Satellites are provided, which will improve the availability and consequently the navigation performance in high urban areas.

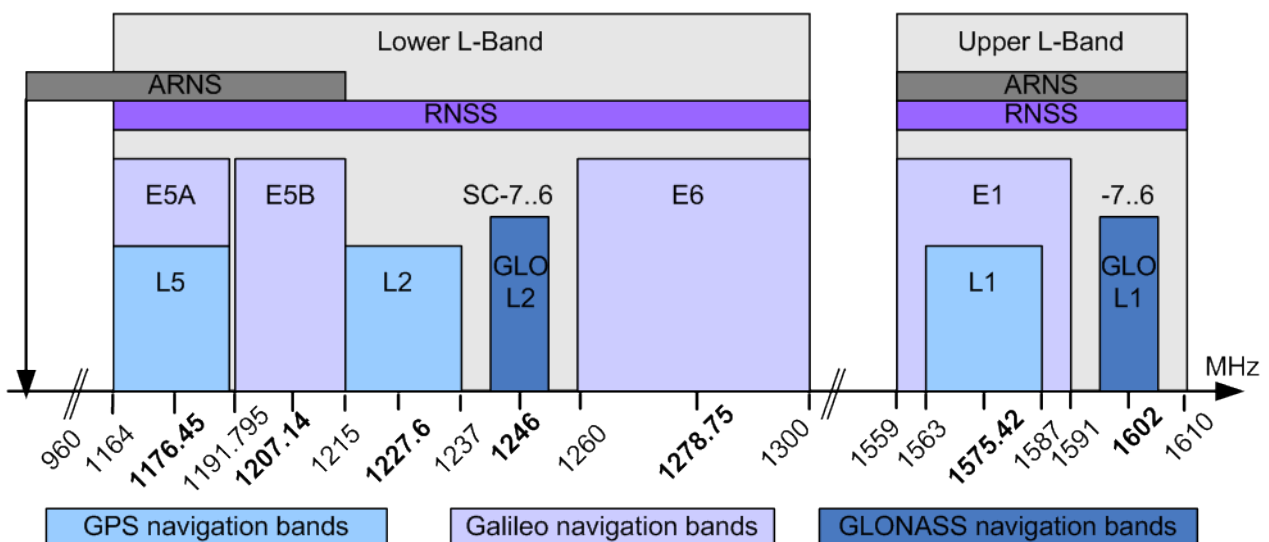


Fig. 2-1: GNSS frequency bands

2.1 Functional Overview of the Basic Realtime GNSS Options GPS, Galileo and GLONASS

This chapter gives an overview of the options GPS (R&S SMBV-K44), Galileo (R&S SMBV-K66) and GLONASS (R&S SMBV-K94).

2.1.1 Real-time generation

With the option R&S SMBV-K44, up to six GPS satellites transmitting L1 and L2 signals with C/A-code can be simulated in real-time.

With the option R&S SMBV-K66, up to six Galileo satellites transmitting E1 signal can be simulated in real-time.

2.1.2 Multi-satellite GNSS signal

The instrument calculates a multi-satellite GNSS signal in three different simulation modes, the static mode, the auto localization mode and the user localization mode.

In "Static mode", static satellites with constant Doppler shifts are provided for simple receiver test, like receiver sensitivity, acquisition and tracking test, etc. production tests. Selection and configuration of any localization data, such as receiver location for instance, is not enabled.

The generic workflow is described in [chapter 2.8.2, "Generating GNSS Signal for Simple Receiver Tests \(Static Mode\)"](#), on page 25.

The superposition signal of up to 6 dynamic satellites at a specific receiver location is generated in one of the localization modes. The major difference to the static mode implies the possibility to specify the receiver's location. Although, both the localization modes are provided for the [generation of a realistic GNSS signal](#), there are some differences between them.

- The "Auto Localization" mode is provided for the generation of a GNSS signal with automatic exchange of satellite whenever needed to improve the position dilution of precision and to ensure satellite visibility at the simulated receiver location. This mode ensures an optimal satellite constellation, automatic dynamic calculation of the satellite power at any moment and ephemeris projection from the selected **almanac**. In this simulation mode, the connected GNSS-receiver can be forced to obtain a 3D fix at a predefined or user-defined static geographical location. Simulation of moving receiver is also possible, but this requires an instrument equipped with the option GNSS enhanced (e.g. moving scenarios, multipath) R&S SMBV-K92 (see [chapter 2.6.1, "Moving Scenarios"](#), on page 21).
- The "User Localization" mode provides flexible configuration of the satellite constellation, the power settings and the individual satellites parameters. For instruments equipped with assistance option R&S SMBV-K65, this mode also enables the extraction of the navigation message from [RINEX](#) files. Dynamic exchange of satellites can be performed by means of deactivation and activation of the individual satellites. The power settings are enabled for configuration but the automatic dynamic calculation function of the instrument may also be utilized.

This mode is required for the generation of user defined assisted GPS test scenarios.

The [table 2-1](#) gives an overview of the supported functionality per simulation mode. Some functionality require additional options.

Table 2-1: Cross-reference between the simulation mode, supported functionality and the required options

Simulation Mode / Function	Static	Auto Localization	User Localization	Required Options
Configuration of static receiver location	no	yes	yes	R&S SMBV-K44/K66
Hybrid Configuration	yes	yes	yes	R&S SMBV-K44 and R&S SMBV-K66
Almanac/RINEX	almanac	almanac	Almanac and RINEX file supported	R&S SMBV-K44/K66 R&S SMBV-K65 for GPS RINEX files
Moving scenarios, Waypoint and NMEA	no	yes	yes	R&S SMBV-K92
Projection of Navigation Message	no	yes	yes	R&S SMBV-K44/K66
Time Conversion Configuration	yes	no	yes	R&S SMBV-K92
S.P.O.T. Display	no	yes	yes	R&S SMBV-K44/K66
Assistance Data Generation	no	no	yes	R&S SMBV-K44 and R&S SMBV-K65
Configuration of Satellite Constellation	yes	no	yes	R&S SMBV-K44/K66
Maximum Number of Satellites	up to 12/24	up to 12/24	up to 12/24	R&S SMBV-K91/K96
Power Mode	User	Auto	Auto and User	R&S SMBV-K44/K66
Navigation Message Configuration	configurable	read-only	configurable	R&S SMBV-K92
Atmospheric Configuration	yes	yes	yes	R&S SMBV-K92
Configuration of Multipath	no	no	yes	R&S SMBV-K92
Exchange of Satellites	no	automatic	manual	R&S SMBV-K44/K66

2.1.3 Hybrid Configurations

Instrument equipped with the GNSS basic options GPS, Galileo and GLONASS can be configured to generate the signal of hybrid satellite constellation with radio signals of all navigation standards. Mixed configurations are enabled only in the common or close-range frequency bands, e.g. L1/E1.

2.1.4 Multiple almanacs

The instrument supports the configuration of the almanac files used. One almanac file per GNSS navigation standard can be selected.

The Galileo satellite constellation is not yet in orbit. Hence, no almanac files for Galileo are available. In this implementation, Galileo almanac files are provided for test purposes. The almanac files for GPS and Galileo use the same format.

Functional Overview of the Basic Realtime GNSS Options GPS, Galileo and GLONASS

Current GNSS almanac data can be downloaded via the Internet and stored on the hard disk of the instrument:

- U.S.Coast Guard Navigation Center GPS Homepage <http://www.navcen.uscg.gov/GPS/almanacs.htm>
The almanac files are named `xxx.alm` (for YUMA files) or `xxx.al3` (for SEM files) whereas `xxx` denotes the day of a year.
- <http://www.celestrak.com/GPS/almanac/>
The naming convention of the almanac file is: `almanac.sem/yuma.weekXXXX.YYYYYY.txt` whereas `xxxx` denotes the GPS week and `yyyyyy` the time of almanac (TOA).
- <ftp://ftp.glonass-iac.ru/MCC/ALMANAC/>
The file extension of the Glonass almanac file is: `xxx.agl`

For detailed information on the content and frame structure of navigation data, refer to the specifications.

2.1.5 On-the-fly configuration of the satellites constellation

The simulation mode "User Localization" makes the satellite constellation user-definable. Not only the individual satellite parameters and the navigation message parameters are enabled for configuration, but active satellites can be turned off or the satellite constellation can be extended with new satellites at any time and **on-the-fly**, without causing an interruption of the currently running signal calculation. Changes in ephemeris of an active satellite and the power settings are performed without signal calculation restart, too. Hence, satellites ephemeris adjustment can be performed during the time the satellite is disabled and the updated parameters will be used from the moment this satellite is active again. This functionality can be used to perform manual exchange of satellite's at user defined moment of time.

This on-the-fly re-configuration during signal generation is especially beneficial by time consuming measurements or test.

2.1.6 Signal generation with projection of the ephemeris navigation data

The instrument employs a special algorithm for projecting the ephemeris navigation data that allows the generation of a navigation message without limitation in the simulation time. The ephemerides are updated and there is no limitation problem of maximum allowed time span of two hours between the simulation time and the TOE (Time of Ephemeris).

2.1.7 Dynamic exchange of satellites

In this implementation, the exchange of satellites can be performed automatically or be configured and triggered by the user.

- To enable the instrument to perform automatic exchange of satellites, select the "Auto Localization" mode.

In this mode, the instrument constantly monitors and updates the simulated satellite's constellation based on two criteria, the optimal satellite constellation with minimum PDOP and the satellite's visibility respecting the [Elevation Mask](#). While the PDOP is a constellation parameter that is calculated by the instrument and displayed in real-time, the satellite's visibility is a satellite parameter which indicates that the satellite elevation at a specific user location is above a configurable elevation mask.

Depending on the current satellite's conditions and the used number of satellites, a sophisticated algorithm decides how often the PDOP and the satellite's visibility have to be proved and at which moment of time the satellite's constellation has to be changed. Satellites that do not fulfill the criteria for minimum PDOP and sufficient visibility are exchanged **dynamically and on-the-fly**. Information about the expected time of the next upcoming exchange is provided by the parameter [Get Next Handover Time](#).

The generic workflow is described in [chapter 2.8.3, "Generating GNSS Signal with Automatic Dynamic Exchange of the Satellites \(Auto Localization Mode\)"](#), on page 25.

- In "User Localization" mode the exchange of the satellites is not performed automatically, but the satellite's constellation is fully configurable. Satellites can be turned off, reconfigured and turned on again, the existing satellite constellation can be extended with new satellites. Hence, an exchange of the satellites can be configured and performed at any moment of time, as defined by the user.

The generic workflow is described in [chapter 2.8.4, "Generating GNSS Signal with Manual Exchange of the Satellites \(User Localization Mode\)"](#), on page 25.

2.1.8 Flexible power configuration and automatic dynamic power control

The instrument employs a dynamic power control concept. To provide better flexibility, two power modes are provided, the "Auto" and the "User" power modes.

- "User" power mode is intended for dynamical configuration of the power of each satellite separately and manually.
- "Auto" power mode enables an internal dynamical automatic power control. The power is calculated automatically based on the satellite-to-receiver distance which varies with the time.

Refer to [chapter 3.4.1, "Power Configuration"](#), on page 55 for examples and information about the power calculation.

The generic workflow is described in [chapter 2.8.11, "Adjusting the Power Settings"](#), on page 30.

2.1.9 Simulation of uninterrupted location fix

The simulation of uninterrupted location fix requires a GNSS signal that fulfills the following conditions:

- An optimal satellite's constellation is selected and monitored constantly, i.e. the exchange of the satellites is performed automatically

- The power of the satellites is monitored and updated constantly depending on the satellite-to-receiver distance and some channel parameters, e.g. atmospheric effects.
- The age of the ephemeris is respected, i.e. the simulation time is always within the allowed time span of $t_{oe} + 2h$.

The [table 2-2](#) gives an overview how these criteria are fulfilled by the provided localization modes.

Table 2-2: Criteria for the generation of GNSS signal for simulation of uninterrupted location fix

Criteria Simulation Mode	Optimal Satellite's Constellation	Power Monitoring and Update	Age of Ephemeris ($t - t_{oe}$) $\leq 2h$
"Auto Localization"	selected and updated automatically automatic dynamic exchange of the satellites	performed automatically in "Auto" power mode	projection of the ephemeris from the almanac
"User Localization"	initial optimal satellite's constellation manual user-defined exchange of the satellites	performed automatically in "Auto" power mode	projection of the ephemeris or many ephemeris pages are made available

Hence, both localization modes provide a realistic signal; the decision which localization mode will be used is a trade-off between the much better accuracy of the ephemeris retrieved from a RINEX file or a manual ephemeris configuration and the automatic selection of the optimal satellite's constellation with automatic exchange of the satellites.

The generic workflow is described in [chapter 2.8.3, "Generating GNSS Signal with Automatic Dynamic Exchange of the Satellites \(Auto Localization Mode\)"](#), on page 25 and [chapter 2.8.4, "Generating GNSS Signal with Manual Exchange of the Satellites \(User Localization Mode\)"](#), on page 25.

2.1.10 Real-Time S.P.O.T. display

The real-world situation of disappearance and re-appearance of satellites, as well as the dynamic display of several parameters like HDOP, PDOP, receiver's location, elapsed time and the trajectory of a moving receiver can be observed in real-time in the special "Real-Time S.P.O.T." (Satellites and Position Online Tracker) display. The displayed values are updated every 5 seconds.

The [Real-Time S.P.O.T.](#) display is enabled for "Auto Localization" and "User Localization" modes.

2.2 Realtime Option GPS P-Code (R&S SMBV-K93)

The option GPS P-Code (R&S SMBV-K93) is only available for instruments equipped with option GPS (R&S SMBV-K44). It enhances the option GPS with military P-Code

Enhancements of Realtime Option Assisted GPS (R&S SMBV-K65)

functionality and allows the configuration of P or C/A+P satellite signals in addition to the civilian C/A signal enabled by the basic GPS option (R&S SMBV-K44).

P-Codes are one week long codes with a high chip rate 10.23 MHz. The higher chip rate significantly increases the performance compared to the civilian C/A codes used by commercial receivers, i.e. P-Code signal provide better Carrier to Noise sensitivity. Another difference compared to the C/A signals is that P-Code signals are only sensible to less than 30 m multipath delay whereas C/A signals are sensible to 300 m.

The generic workflow is described in [chapter 2.8.9, "Generating GPS Signal Modulated with P Code"](#), on page 28.

2.3 Enhancements of Realtime Option Assisted GPS (R&S SMBV-K65)

The option Assisted GPS (R&S SMBV-K65) is only available for instruments equipped with option GPS (R&S SMBV-K44). It enhances the option GPS with functionality required for A-GPS test scenarios for 3GPP FDD and GSM.

2.3.1 Support of RINEX files

Additionally to the almanac files, a Receiver Independent Exchange Format RINEX files are supported. RINEX files are very well known and are standard formats generated by Control Stations (CS) and many commercial receivers. RINEX Navigation Files usually comprise the ephemeris sets for several satellites with different TOE and TOC. Hence, only one RINEX File is enough to describe satellite orbits for a period longer than 2 hours and sometimes up to 1 day.

Current RINEX files can be downloaded via the Internet and stored on the hard disk of the instrument, e.g. http://cddis.gsfc.nasa.gov/gnss_datasum.html#brdc.

2.3.2 Full set of pre-defined test scenarios for A-GPS 2G/3G Protocol and Conformance Test Cases

An instrument equipped with the option Assisted GPS supports test scenarios for A-GPS Protocol and Conformance Test cases. Some of the test cases may require additional options.

The [table 2-3](#) lists the currently supported predefined A-GPS test scenarios.

Table 2-3: Test Scenarios Overview

Test Scenario	Description	Required SW Option
GSM		
GSM Signaling Scenario	A-GPS GSM test scenarios acc. to 3GPP TS 51.010-1 v.7.7.0	R&S SMBV-K44/-K65

Enhancements of Realtime Option Assisted GPS (R&S SMBV-K65)

Test Scenario	Description	Required SW Option
GSM Performance Test Scenario 1	A-GPS GSM test scenarios acc. to 3GPP TS 51.010-1 v.7.7.0	R&S SMBV-K44/-K65
GSM Performance Test Scenario 2	A-GPS GSM test scenarios acc. to 3GPP TS 51.010-1 v.7.7.0	R&S SMBV-K44/-K65
GSM Performance Test Scenario 3	A-GPS GSM test scenarios acc. to 3GPP TS 51.010-1 v.7.7.0	R&S SMBV-K44/-K65/-K92
3GPP FDD		
3GPP FDD Signaling Scenario	A-GPS 3GPP FDD test scenarios acc. to 3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0	R&S SMBV-K44/-K65
3GPP FDD Performance Test Scenario 1	A-GPS 3GPP FDD test scenarios acc. to 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1	R&S SMBV-K44/-K65
3GPP FDD Performance Test Scenario 2	A-GPS 3GPP FDD test scenarios acc. to 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1	R&S SMBV-K44/-K65
3GPP FDD Performance Test Scenario 3	A-GPS 3GPP FDD test scenarios acc. to 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1	R&S SMBV-K44/-K65/-K92
3GPP2		
3GPP2 Static Test Scenario	A-GPS 3GPP2 test scenarios acc. to 3GPP2 C.S0036-0 V1.0	R&S SMBV-K44/-K65
3GPP2 Moving Test Scenario	A-GPS 3GPP2 test scenarios acc. to 3GPP2 C.S0036-0 V1.0	R&S SMBV-K44/-K65/-K91/-K92

The generic workflow is described in [chapter 2.8.6, "Generating A-GPS Test Signal"](#), on page 27.

2.3.3 Custom build scenarios

The option Assisted GPS (R&S SMBV-K65) is not limited to be used for A-GPS testing exclusively. Despite the predefined scenarios, it is also possible to define any user-specific test scenario.

For testing of stand-alone GPS receivers, the option Assisted GPS offers full flexibility on the simulated satellites including definition of the satellite's orbit and the complete navigation message. The simulation mode "User Localization" can be used to get an optimal satellite's constellation and to adjust the navigation message to the exact requirements.

The generic workflow is described in [chapter 2.8.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 26.

2.3.4 Generation of assistance data

Besides generating the satellite signals for an A-GPS test scenario, the option Assisted GPS (R&S SMBV-K65) is also able to provide all kinds of assistance data in line with the simulated scenario which can be provided to the UE by a protocol tester.

Certainly, this also applies to user-defined A-GPS test scenarios.

Refer to [chapter 2.7.1, "Example of A-GPS Test Setup"](#), on page 22 for an example of the A-GPS setup. The generic workflow is described in [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27.

2.4 Realtime Option Extension to 12 Satellites (R&S SMBV-K91)

This options extends the maximum number of simulated satellites. Instruments equipped with this option are enabled to generate the signal of up to 12 configurable satellites.

2.4.1 Channel Budget

In instruments without option R&S SMBV-K91, any hybrid 6-satellite configuration is possible depending on the availability of the basic options, respectively on the enabled standards in "Hybrid Configurations" and the selected "RF Band".

If the R&S SMBV-K91 option is installed however, the instrument's hardware limits the maximum number of simulated satellites, depending on whether P code signal are configured in hybrid configuration or not. The generation of 12-satellites hybrid signal is guaranteed when no military GPS satellites are activated. With activated civilian and military GPS satellites, only a subset of hybrid configurations are possible (see [table 2-5](#)).

The [table 2-4](#) describes the number of civilian C/A and military P resource units needed per signal when GPS and Military GPS are activated in Hybrid Configuration.

Table 2-4: Number of resource units required per signal

Standard	Required option	"Signal"	c Civilian C/A resource units	p Military P resource units
GPS	R&S SMBV-K44	C/A	1	0
			0	1
	R&S SMBV-K44 and R&S SMBV-K93	P	0	1
			(C/A+P)Q	1
			0	2
Galileo	R&S SMBV-K66	E1	2	0

Standard	Required option	"Signal"	c Civilian C/A resource units	p Military P resource units
			1	1
			0	2
GLONASS	R&S SMBV-K94	R-C/A	1	0
			0	1

Example:

Let "c" corresponds to the civilian resource unit and "p" to the military resource units.

According to the table, the GPS (C/A+P)Q signal requires 1c + 1p or 2p units.

The total available budget when GPS and Military GPS are activated in hybrid configuration is 8c + 8p.



Instruments equipped with R&S SMBV-K92 can generate multipath signal. The generation of multipath satellite signal with n taps requires n times more resource units.

Example:

The [table 2-5](#) lists some of the GNSS constellations that can be achieved based on the [table 2-4](#).

Table 2-5: Possible GNSS hybrid configurations

GPS (C/A +P)Q signal	GPS P signal	GPS C/A signal	Galileo E1 signal	GLONASS R-C/A signal
8	0	0	0	0
7	0	0	0	2
6	0	0	1	2
5	0	0	2	2
4	4	4	0	0
4	4	2	0	2
4	0	8	0	0
4	0	4	0	4
4	0	0	0	8
4	0	0	4	0
4	0	3	2	1
4	0	0	3	2
4	0	0	2	4
4	0	0	1	6
3	0	0	3	4

Realtime Option Extension to 24 Satellites (R&S SMBV-K96)

GPS (C/A +P)Q signal	GPS P signal	GPS C/A signal	Galileo E1 signal	GLONASS R-C/A signal
2	0	0	4	4
1	0	0	3	8

2.5 Realtime Option Extension to 24 Satellites (R&S SMBV-K96)

This option requires the option R&S SMBV-K91 and further extends the maximum number of simulated satellites.

Instruments equipped with the combination R&S SMBV-K91 and R&S SMBV-K96 are enabled to generate the signal of up to 24 GPS C/A and/or Glonass satellites if R&S SMBV-K44 and/or R&S SMBV-K94 are respectively available; the actual number of Galileo or military GPS satellite signals is not affected.

2.5.1 Channel Budget

For enabled [Use Military GPS \(P\)](#) or [Maximum Number of Satellites](#) is less or equal to 12, the rules described in [chapter 2.4.1, "Channel Budget"](#), on page 18 apply.

The generation of 24-GPS C/A and/or GLONASS satellites hybrid signal is guaranteed when no military GPS satellites are activated. Based on the overview provided in [table 2-4](#) and for the [Use Military GPS \(P\)= Off](#) case the following rules apply:

- The total number of available resource units is 24c
- A GPS or a GLONASS satellite/multipath tap requires 1c
- A Galileo satellite/multipath tap requires 2c

Hence, only a subset of hybrid configurations are possible.

Example:

The [table 2-6](#) lists some of the GNSS constellations with 24 satellites that can be achieved.

Table 2-6: Possible GNSS hybrid configurations with 24 satellites

GPS C/A signal	Galileo E1 signal	GLONASS R-C/A signal
24	0	0
12	0	12
8	4	8
etc.		

2.6 Functional Overview of Realtime Option GNSS Enhanced (R&S SMBV-K92)

This option is required for the simulation of moving receivers, for the generation of multipath signal, to enable the configuration of atmospheric effects, the system time conversion and leap second simulation parameters.

2.6.1 Moving Scenarios

The option GNSS enhanced (R&S SMBV-K92) enhances the basic satellite navigation options GPS (R&S SMBV-K44/-K65) and Galileo (R&S SMBV-K66) by user-definable moving scenarios. Moving scenarios are required for the A-GPS test scenarios for 3GPP FDD and GSM (Performance Test Scenario#3), as well as for the CDMA test case "3GPP2 Moving Test Scenario". They can also be used for testing stand-alone GPS-receivers. The user has the possibility to define a movement by means of a so-called "waypoint" file, which will lead to a "moving" of the connected GPS-receiver.

Another way to simulate moving receiver is provided by the NMEA files. NMEA is a standard format used in GNSS. The receiver can export a navigation information, e.g. location, from the NMEA files.

For detailed description of the waypoint file format, refer to [Movement Files](#).

2.6.2 Multipath signal generation

The instrument provides the possibility to simulate the GNSS signal of one or more satellites that undergoes static multipath propagation effects.

The generic workflow is described in [chapter 2.8.8, "Generating Multipath Scenarios"](#), on page 28.

2.6.3 Configuration of the atmospheric parameters

In instruments equipped with the option GNSS enhanced (R&S SMBV-K92), the ionospheric navigation parameters and both ionospheric and tropospheric models of the installed GNSS standards are enabled for configuration.

Activation and deactivation for the ionospheric and tropospheric models can be used to simulate variation in the pseudorange of the corresponding GNSS satellites. The ionospheric navigation parameters only define what the satellites are transmitting as ionospheric correction parameters whereas the model configuration describes the actual ionospheric and tropospheric models used in the satellite-receiver channel simulation.

2.6.4 Time conversion configuration

The instrument supports an advanced function for transformation of the GNSS time to the universal time coordinate basis (UTC) and vice versa. The provided GNSS system

time conversion parameters are zero-order and first order system clock drift parameters in addition to the current leap second. The leap second describes the difference between the GPS or Galileo system time and UTC system time. Hence, it is possible to simulate a system time drift between GPS and Galileo by configuring different time conversion sets for both UTC-GPS and UTC-Galileo conversion parameters.

The time conversion parameters can be either manually configured or fetched from the RINEX header. It is recommended to keep the default configurations without system time offset and/or drift.

2.6.5 Leap second simulation

The instrument enables the simulation of leap second in a straightforward way. The simulation requires only the date and sign of the next leap second, further calculations are performed automatically.

2.7 Realtime Test Setups

2.7.1 Example of A-GPS Test Setup

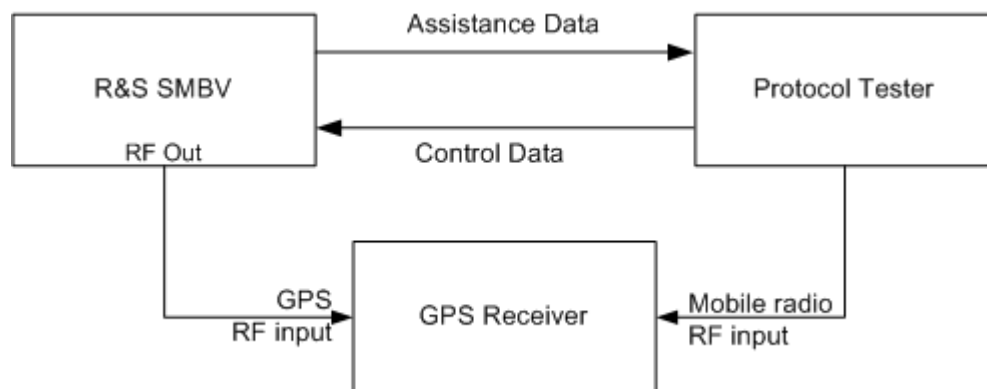


Fig. 2-2: Example of A-GPS Test Setup

2.8 Typical Realtime Workflow



The workflow examples provided in this chapter assume an instrument, fully equipped with all available GNSS options.

2.8.1 General Workflow

This section introduces the general workflow for configuring the primary settings, that are common for almost all further configurations workflow. The block diagram on the following figure shows an overview of the common configuration steps.

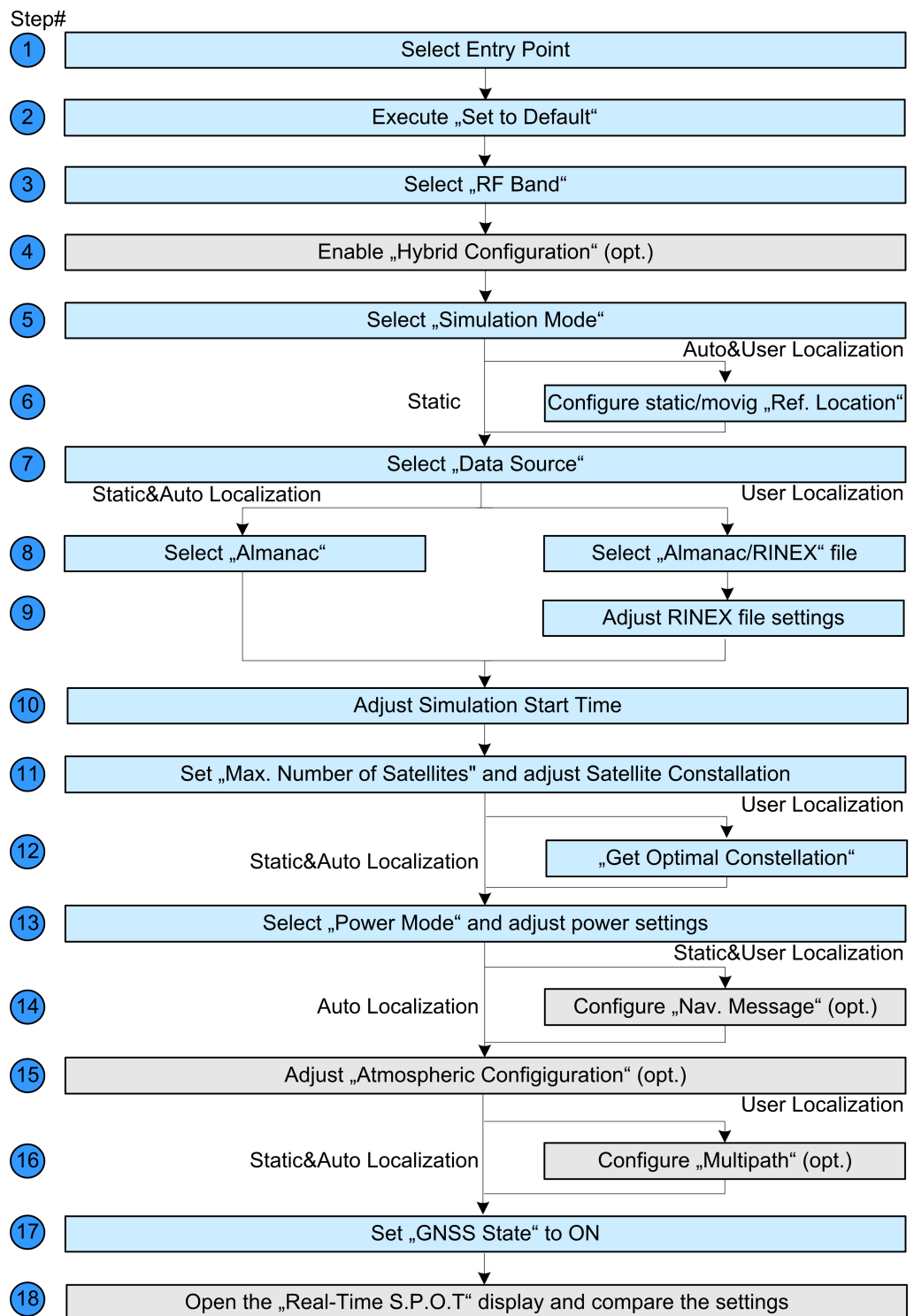


Fig. 2-3: General workflow

2.8.2 Generating GNSS Signal for Simple Receiver Tests (Static Mode)

1. Perform steps 1 to 3 according to [General Workflow](#).
2. If required, enable "Hybrid Configuration".
3. Select "GNSS Main Dialog > Simulation Mode > Static".
4. Perform relevant steps 7 to 15 from [General Workflow](#).
5. Select "GNSS Main Dialog > State > ON".

The generated GNSS signal is calculated according to the satellite configuration settings, the selected almanac file and selected moment of time (date and time).

2.8.3 Generating GNSS Signal with Automatic Dynamic Exchange of the Satellites (Auto Localization Mode)

1. Perform steps 1 to 3 according to [General Workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > Auto Localization".
3. Perform relevant steps 7 to 15 from [General Workflow](#).
4. Select "GNSS Main Dialog > State > On".

The instrument generates the GNSS signal for the selected satellites' constellation, calculated to fulfill the minimum PDOP and satellite visibility criteria. The selected satellites are dynamically and on-the-fly exchanged as soon as an exchange of satellites is necessary. The satellites parameters displayed in the "Satellite Configurations" dialog and the "Navigation Message" parameters are read-only.

Open the [Real-Time S.P.O.T.](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP/HDOP", "Receiver Location" and simulation "Time" are also displayed. If a moving receiver has been configured, the "Real-Time S.P.O.T. > Map View" displays the trajectory the receiver should have.

2.8.4 Generating GNSS Signal with Manual Exchange of the Satellites (User Localization Mode)

1. Perform steps 1 to 3 according to [General Workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Perform steps 7 to 16 from from [General Workflow](#).
 - a) It is recommended to select a RINEX file, if one exists.
For more information, see [chapter 2.8.10, "Configuring the Navigation Parameters"](#), on page 29.

- b) If required, select "GNSS Main Dialog > Satellite Configuration > Atmospheric Configuration" and adjust the settings.
 - c) If required, select "GNSS Main Dialog > Satellite Configuration > Time Conversion Configuration" and adjust the settings.
 - d) Select "GNSS Main Dialog > Satellite Configuration > Power Mode > Auto" to enable the dynamic automatic calculation of the power level and adjust the required power settings.
For more information, see [chapter 2.8.11, "Adjusting the Power Settings"](#), on page 30.
4. Select "GNSS Main Dialog > State > On".
The instrument generates the GNSS signal for the selected satellites' constellation. The satellite parameters can be additionally reconfigured to simulate multipath effects for instance (see also [chapter 2.8.8, "Generating Multipath Scenarios"](#), on page 28).
Open the [Real-Time S.P.O.T.](#) display to show the position of the active and inactive satellites. The current values of the parameters "PDOP/HDOP", "Receiver Location" and simulation "Time" are also displayed. If a moving receiver has been configured, the "Real-Time S.P.O.T. > Map View" displays the trajectory the receiver should have.
 5. To trigger a manual satellite's exchange for Sat#3 for instance, select "GNSS Main Dialog > Satellite Configuration > Sat#3 > State > Off".
 6. Select "Satellite Configuration > Sat#3 > Navigation Message" and adjust the parameters as required.
 7. Enable the satellite again or add a new satellite to the satellite's constellation.
The [Real-Time S.P.O.T.](#) displays the updated position of the active and inactive satellites.

2.8.5 Generating A-GPS Custom Build Scenarios (User Localization Mode)

1. Perform steps 1 to 3 according to [General Workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Perform steps 7 to 16 from from [General Workflow](#).
 - a) It is recommended to select a RINEX file, if one exists.
For more information, see [chapter 2.8.10, "Configuring the Navigation Parameters"](#), on page 29.
 - b) Disable "Satellite Configuration > Global Ephemeris Real-Time Projection".
 - c) Select "Satellite Configuration > Sat# > Navigation Message" and adjust the parameters as required.
Note: The parameters "Satellite Configuration > Global Ephemeris Real-Time Projection" and "Satellite Configuration > Sat# > Navigation Message > Real-Time Projection" must be disabled!

- d) Select "GNSS Main Dialog > Satellite Configuration > Power Mode > User" and adjust the required power settings.
For more information, see [chapter 2.8.11, "Adjusting the Power Settings"](#), on page 30.
4. Select "GNSS Main Dialog > State > On".
5. Generate the required "Assistance Data" (see also [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27).
The instrument generates an A-GPS signal according to the settings made.

2.8.6 Generating A-GPS Test Signal

The generic workflow for generation of A-GPS test scenarios in conformance to A-GPS 2G/3G Protocol and Conformance Test Cases is as follow:

1. Execute "GPS Main Dialog > Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select "GPS Main Dialog > Test Scenario" and select a predefined GSM, 3GPP FDD or 3GPP2 (CDMA2000) test scenario.
3. Select "GNSS Main Dialog > State > ON".

The instrument generates an A-GPS signal according to the selected test scenario. Refer to the corresponding specification and customize the test scenario signal for the predefined specific test case, i.e. perform the necessary changes on the satellite constellation, receiver location, simulation time and power settings.

2.8.7 Generating GPS Assistance Data

1. Select "GNSS Main Dialog > Simulation Mode > User Localization" and perform the required settings (see e.g. [chapter 2.8.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 26).
2. Execute "GNSS Main Dialog > Assistance Data > Synchronize All" to align the assistance data settings with the settings that have been already made.
3. If required, reselect the space vehicles for which assistance data is to be generated.
4. Reconfigure the reference location (i.e. enter the coordinates of the BS location instead of receiver location).
5. Adjust the "Duration" and the "Resolution" of assistance data.

6. Generate the required assistance data (almanac file, ionospheric file, etc.).

The generated assistance data files are saved in the selected folder. Refer to the description of the corresponding file for description of the file format used.

2.8.8 Generating Multipath Scenarios

1. Perform steps 1 to 3 according to [General Workflow](#).
2. Select "GNSS Main Dialog > Simulation Mode > User Localization".
3. Select "Satellite Configuration > Sat# > Multipath".
4. Select the "Number of Taps" and configure the additional "Time Shift", "Power", "Doppler Shift" and "Carrier Phase" per tap.
5. Select "Multipath Configuration > State > On".

The graph displays the selected propagation conditions.

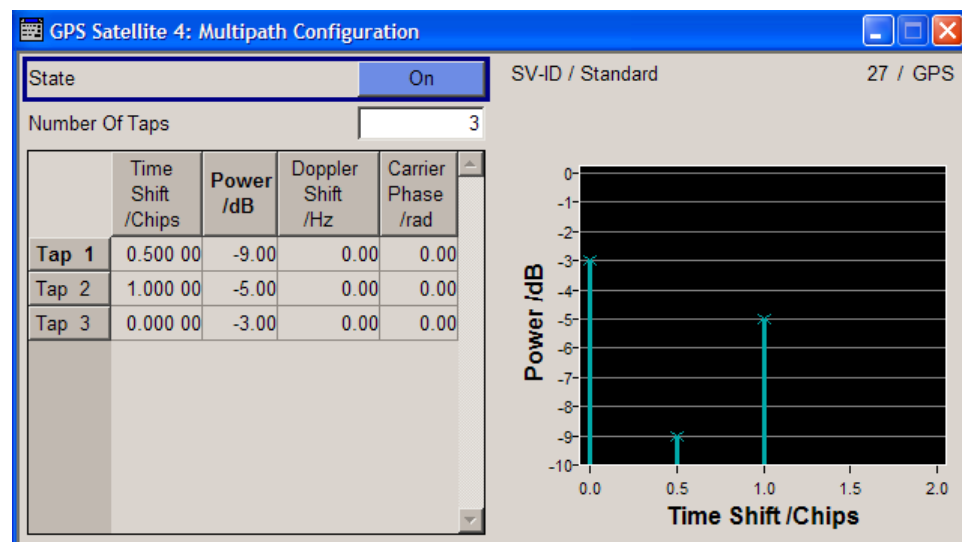


Fig. 2-4: Example of "Multipath Configuration"

6. Select "GNSS Main Dialog > State > On".

The instrument will generate the GNSS signal of satellites that experience static multipath propagation.

2.8.9 Generating GPS Signal Modulated with P Code

1. Perform steps 1 to 3 according to [General Workflow](#).
2. In the "Hybrid Configuration" dialog enable "Activate GNSS Standards > GPS".
3. Enable "Hybrid Configuration > Use Military GPS (P)".

4. In "Simulation Mode > User Localization", select "Satellite Configurations > Sat# > Standard > GPS" and enable "Signals > P" or "C/A+P" for this GPS satellite as required.

Tip: Not enough hardware resources. This warning message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid constellations, multipath configurations, signals modulated by P code and activated satellites consume hardware resources. Refer to [chapter 2.4.1, "Channel Budget"](#), on page 18 for description on the how the available hardware resources are distributed.

5. In "Simulation Mode > Auto Localization", select "Satellite Configurations > Global Signal Config" and adjust the signals of the GPS satellites.
6. Perform relevant steps 5 to 18 from [General Workflow](#).
7. Select "GNSS Main Dialog > State > ON".

The instrument generates the GNSS signal for the selected satellites' constellation.

2.8.10 Configuring the Navigation Parameters

Extracting the navigation message from the almanac file

- ▶ Select "GNSS Main Dialog > Almanac" and select an almanac file.

The almanac file is used to extract all navigation parameters. These parameters are transmitted as part of the navigation message.

Manual configuration of the navigation parameters

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > Satellite Configuration > Sat# > Navigation".
3. Adjust the "Navigation Message Configuration > Number of Pages"
4. Select "Navigation Message Configuration > Page Number" and configure the content of the selected ephemeris page(s).
5. Repeat steps 2 to 4 for all GNSS satellites

Extracting the ephemeris and the satellite clock correction parameters from RINEX file

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > RINEX" and select RINEX file.
3. Perform "Hybrid Configuration > RINEX Configuration > Import RINEX Files".

4. Select "Hybrid Configuration > RINEX Configuration > State On".

The ephemeris and satellite clock correction part of the navigation message are extracted from the selected RINEX file and used to simulate the position of the GPS satellites.

The ephemeris and the clock correction parameters of all satellites that are not available in the RINEX files or had not been configured manually are extracted from the selected almanac.

Extracting the ionospheric and time conversion parameters from RINEX file

1. Select "GNSS Main Dialog > Simulation Mode > User Localization".
2. Select "GNSS Main Dialog > RINEX" and select RINEX file.
3. Perform "Hybrid Configuration > RINEX Configuration > Import RINEX Files".
4. Enable "Hybrid Configuration > RINEX Configuration > Update UTC and Atmospheric Parameters".
5. Select "Hybrid Configuration > RINEX Configuration > State On".

The ionospheric and time conversion parameters are extracted from the header of the selected RINEX file.

If required, adjust the extracted ionospheric and time conversion parameters.

2.8.11 Adjusting the Power Settings



Refer to [chapter 3.4.1, "Power Configuration"](#), on page 55 for explanation and example on the power level calculation.

Power settings in "Auto" power mode

1. Select "GNSS Main Dialog > Satellite Configuration > Power Mode > Auto".
2. Set the "Satellite Configuration > Reference Power".
3. Set the "Satellite Configuration > Reference Satellite".
4. If "Hybrid Configuration" is activated, select "Satellite Power Tuning > Inter-Standard Tuning > Set to Standard" to simulate the nominal power difference between the GNSS standards as defined in the standard.
5. For the satellites undergoing static multipath effects:
 - a) Select "Sat# > Multipath Configuration > Power" and adjust the power level of the corresponding fading tap.
 - b) Enable "Multipath Configuration > State > On".
6. Set "GNSS Main Dialog > State > On".

The power level of the generated GNSS signal is displayed with the parameter "Total Power".



The power levels displayed in the "Satellite Configuration > Constellation Table" are the power level at the simulation's start moment.

Select "Real-Time SPOT > Display Type > Power View" to display the current power levels.

Power settings in "User" power mode

1. Select "GNSS Main Dialog > Satellite Configuration > Power Mode > User".
2. Set the "Satellite Configuration > Reference Power".
3. Set the "Satellite Configuration > Constellation Table > Sat# > Power" level of the individual satellites.
4. For the satellites undergoing static multipath effects:
 - a) Select "Sat# > Multipath Configuration > Power" and adjust the power level of the corresponding fading tap.
 - b) Enable "Multipath Configuration > State > On".
5. If not already enabled, set "GNSS Main Dialog > State > On".

The power level of the generated GNSS signal is displayed with the parameter "Total Power".

2.8.12 Handling NMEA Files

1. On your receiver, record the NMEA messages to a log file with an extension `*.nmea`.
2. Use an external hard disk, USB stick or a LAN connection and transfer this NMEA log file to a network directory or the instrument.
3. Select the "GNSS main dialog > Geographic Location > Waypoints".
4. Select the "GNSS main dialog > Select Waypoint File", navigate to the directory the loaded NMEA file is stored and select the file.

The instrument decodes the logged NMEA file (`*.nmea`) and automatically configures the user location to the values retrieved from the logged file. The information about possible receiver's moving is considered too.

If required, re-configure the automatically applied settings.



The instrument decodes the complete NMEA file but settings related to deactivated or not installed navigation standards are ignored.



Refer to [chapter C, "NMEA Scenarios"](#), on page 221 for detailed description of the NMEA file format.

2.9 Generating GNSS Signal with Several Instruments (Common RF Frequency)

This section provides example on connection and configuration of two R&S SMBV instruments for generating common GNSS signal.

Overview of required relevant options

Instrument#1

- option GPS (R&S SMBV-K44)
- GNSS global option R&S SMBV-K91 (Extension to 12 Satellites)
- generation of more than 12 satellites requires additionally GNSS global option R&S SMBV-K96 (Extension to 24 Satellites)
- option Phase Coherence (R&S SMBV-B90)

Instrument#2

- option GLONASS (R&S SMBV-K94)
- GNSS global option R&S SMBV-K91 (Extension to 12 Satellites)
- generation of more than 12 satellites requires additionally GNSS global option R&S SMBV-K96 (Extension to 24 Satellites)
- option Phase Coherence (R&S SMBV-B90)



In this description, only the GNSS related settings are discussed. For detailed information on cabling and required configuration, refer to:

- R&S SMBV Operating Manual, section "Synchronous Signal Generation"
 - Application Note 1GP67 "Phase Adjustment"
-

The [figure 2-5](#) provides an example of test setup. The two instruments are connected to work in master-slave mode and the local oscillators (LO) are coupled. The first instrument provides the second one with its system clock, trigger, reference and LO signals.

Generating GNSS Signal with Several Instruments (Common RF Frequency)

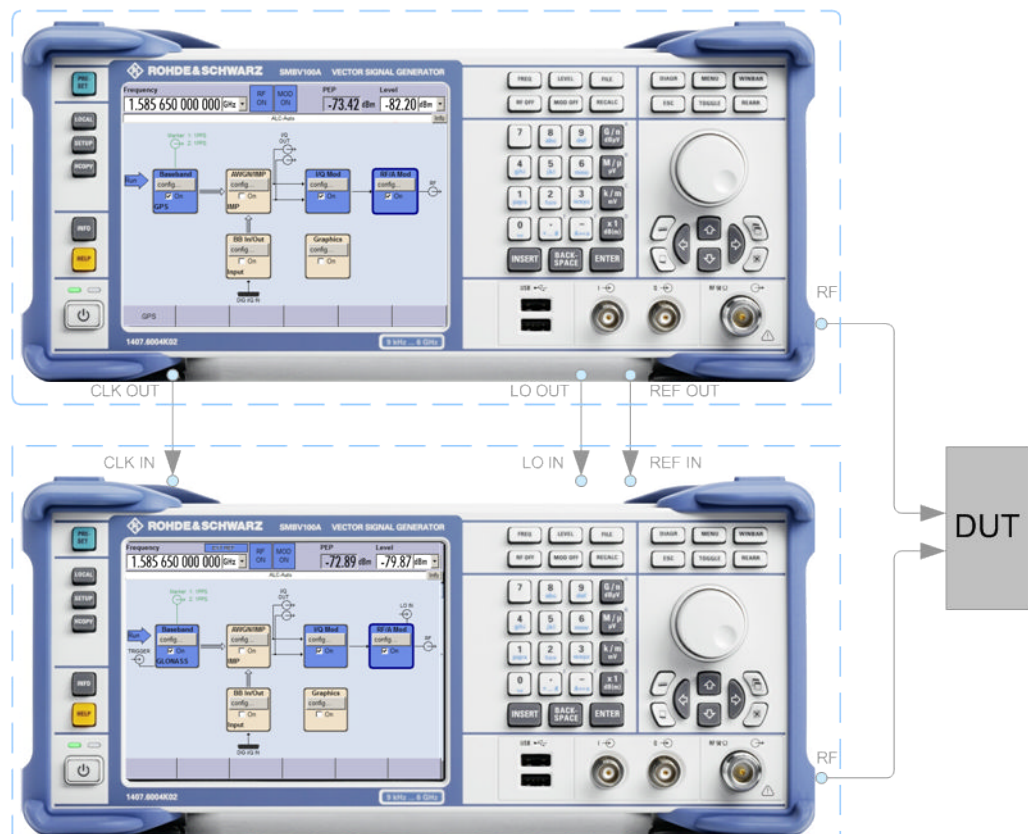


Fig. 2-5: Example: Connecting two R&S SMBV to generate GNSS signal using common RF frequency



The following lists **only the required task related settings**.

1. In the Instrument#1, perform the required steps according to [General Workflow](#) and configure the instrument to generate GPS signal with 12 or more satellites and "RF Band > L1/E1" (see also [figure 2-1](#)).
 - a) Select "GPS > Hybrid Configuration > Use Common RF Frequency > ON".
 - b) Execute "GPS > Update RF Frequency".

The value in the "Frequency" display in the header of the instrument is set to 1.58565 GHz. The GPS signal is however modulated on the GPS frequency L1 = 1.57542 GHz.
2. In the Instrument#2, perform the required steps according to [General Workflow](#) and configure the instrument to generate GLONASS signal with 12 more satellites and "RF Band > L1/E1".
 - a) Select "GLONASS > Hybrid Configuration > Use Common RF Frequency > ON".
 - b) Execute "GLONASS > Update RF Frequency".

The value in the "Frequency" display in the header of the instrument is set to 1.58565 GHz. The GLONASS signal is however modulated on the GLONASS frequency L1 = 1.602 GHz.

2.10 Functional Overview of the Basic Offline GNSS

This chapter gives an overview of the options GPS (R&S SMx/AMU-K244), Galileo (R&S SMx/AMU-K266) and GLONASS (R&S SMx/AMU-K294).

2.10.1 Single-satellite GNSS signal

R&S WinIQSIM2 calculates a single satellite GNSS signal, where static satellites with constant Doppler shifts are provided for simple receiver test, like receiver sensitivity, acquisition and tracking test, etc. production tests. Selection and configuration of any localization data, such as receiver location for instance, is not enabled.

A generic workflow is described in [chapter 2.10.2.1, "Generating an one-satellite static generic GNSS signal with R&S WinIQSIM2"](#), on page 34.

2.10.2 Typical Offline Workflow

This chapter provides some examples of typical workflows, working with option GPS (R&S SMx/AMU-K244).

2.10.2.1 Generating an one-satellite static generic GNSS signal with R&S WinIQSIM2

The generic workflow for generating a GNSS Satellite (GPS, Galileo or GLONASS) signal with R&S WinIQSIM2 and saving it as a waveform is as follow:

1. Execute "Set To Default" to adjust the instrument's settings to a standard set of operating conditions.
2. Select the required "RF Band".
3. Select an arbitrary data or "Real Navigation Data" as "Data Source".
4. When using "Real Navigation Data", use the "Almanac > Almanac File" function and choose an almanac file.
The navigation message will be automatically formed to be conforming to this almanac file.
5. Adjust the "Oversampling" parameter to increase or decrease the sample rate used to generate the GNSS Satellite Signal
6. Adjust the "Duration of Satellites Simulation".
7. Adjust the date and the simulation time (GNSS Mean Time).

8. Select "Satellite Configurations" and configure the satellite as required, e.g. "Space Vehicle ID (SV-ID)" and "Doppler Shift".
For disabled "Real Time Navigation Message", the "Initial Code Phase" and the "Frequency Number" of the GLONASS satellites can be configured.
Tip: For Galileo satellites, enable "BOC(1,1)" modulation instead of "CBOC(6,1)" to reduce the sample rate required to simulate a certain period of time.
9. Set "State > ON" to enable the GNSS Satellite signal generation.
10. Select the "Generate Waveform File" to save the GNSS Satellite signal to a waveform file.

2.10.2.2 Loading and Processing a GNSS Waveform in the ARB of the R&S Signal Generator

The generic workflow for loading and processing of GNSS waveform is as follow:

1. Enable the R&S WinIQSIM2 to generate a one-satellite static generic GNSS signal with constant Doppler shift and generate a waveform file.
2. Connect the R&S WinIQSIM2 to the R&S Signal Generator.
3. Transfer the waveform file. For detailed description, refer to the R&S WinIQSIM2 Software Manual.
4. Load the waveform in the ARB of the R&S Signal Generator.

While loading a waveform in the ARB menu, a message is displayed, that states the frequency used during signal generation ("Resulting Frequency").

Tip: Another possibility is to find out the carrier frequency is to use "ARB Waveform Info".

Note: The carrier frequency of a R&S Signal Generator that processes a waveform generated with the R&S WinIQSIM2 has to match the value of the parameter Resulting Frequency.

5. Select the **FREQ** key to set the frequency in the header of the instrument to the resulting frequency of the generated waveform.
6. Set the "ARB State" to "ON" to enable signal processing.

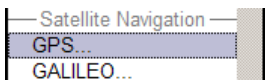
The R&S Signal Generator processes the GNSS signal generated by the R&S WinIQSIM2.

3 User Interface



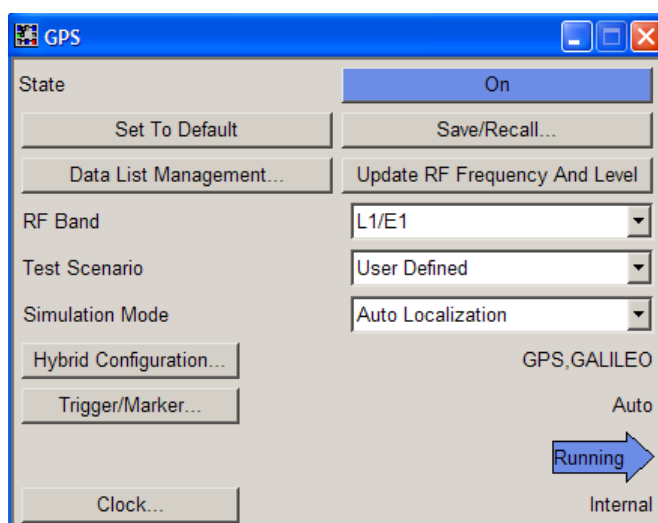
- The instrument may be equipped with different satellite navigation options. To access the available satellite standards, select "Baseband block > Satellite Navigation" and select the desired satellite standard, e.g. GPS. To simplify the description, the selected satellite standard is referred as an "entry standard".
- Since most of the parameters provided for configuration are similar and do not depend on the entry standard, this description uses the SW option GPS/A-GPS (R&S SMBV-K44/-K65) and the GNSS global options R&S SMBV-K91/-K92/-K96 (Extension to 12 and 24 Satellites/GNSS Enhancements) as a reference. Satellite standard dependent settings are described separately or the differences are explicitly stated.
- The GNSS implementation in the R&S WinIQSIM2 is a simplified offline version of the real-time one and provides the capability to generate an one-satellite generic signal. Therefore the relevant parameters are adjusted accordingly in R&S WinIQSIM2. You find the differences explicitly stated in the description.

3.1 GNSS Main Dialog



The dialog is split into several sections for configuring the standard. The choice of simulation mode determines which displays and parameters are made available in the lower section.

The upper section of the menu is where the GNSS digital standard is enabled, the default settings are called and the simulation mode is selected. Buttons lead to the submenus for loading and saving of the GNSS configuration, as well as to the sub-menus for configuring the clock, marker and trigger parameters.



For in the real-time solution, the "Localization Data" dialog section is where the satellite signals are configured corresponding to a 'real' location which can be selected by the user.

Localization Data

Geographic Location: Waypoints

Select Waypoint File... Melbourne

Read Out Mode: Cyclic

Position Format: DEG:MIN:SEC

Altitude: 100.0 m

Latitude: 37 ° 48 ' 59.987 " South

Longitude: 144 ° 57 ' 59.970 " East

The "Navigation Data" menu section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).

Navigation Data

Data Source: Real Navigation Data

Almanac/RINEX... Time Conversion Config...

System Time: UTC

Date [dd.mm.yyyy]: 13.07.2008

Time [hh:mm:ss.s]: 17:04:00.000

The button in the lower section leads to the submenu for configuring the satellite signals. Additional buttons lead to dialogs for generating the assistance data and displaying the "Real-Time S.P.O.T.".

Satellite Configurations... Real-Time S.P.O.T. ...

Assistance Data Generation...

3.1.1 General Settings for GNSS Simulation

The upper section of the menu is where the GNSS digital standard is enabled, the default settings are called. Buttons lead to the submenus for loading and saving the GNSS configuration.

State

Enables/disables the GNSS signal simulation.

Enabling this standard disables all the other digital standards and digital modulation modes.

For R&S SMBV instruments, a continuous GNSS signal is generated for up to 24 satellites in real time mode. The maximum number is determined by the parameter [Maximum Number of Satellites](#) and the maximum value depends on the installed SW options.

For R&S WinIQSIM2, a time limited GNSS signal is generated for one satellite in offline mode. The time limited GNSS Signal is continuously played and repeated in the ARB of the vector signal generator. In this case, the "Restart" marker may be helpful to trigger a GNSS receiver module when simulating an offline generated GNSS Signal.

Note: Enabling the standard sets automatically the "Frequency" and "Level" displayed in the header of the instrument according to the selected settings, e.g. "RF Band" and "Total Power" at the simulation start time!

SCPI command:

[<subsystem>:STATe](#) on page 114

Set to default

Calls the default settings. The following table gives an overview of the settings. The preset value for each parameter is specified in the description of the remote-control commands.

Note: The RF Frequency and level are preset by means of the [Update RF Frequency](#) button.

Parameter	Value
State	Not affected by Set to default
RF Band	L1/E1
Simulation Mode	Static
Almanac	GPS_SEM585/GAL_Yuma585/GLO_585.agl
Oversampling	(R&S WinIQSIM2)
Duration of Satellite Simulation	2 1s
Data Source	PRBS9
System Time	Time basis of the entry standard
Hybrid Configuration	GPS only, Galileo only or GLONASS only depending on the entry standard
Satellite configuration	
Maximum Number of Satellites	1
State satellite 1	On
Standard	GPS, Galileo or GLONASS (depending on the entry standard)
Signal	C/A, E1-DEF or R-C/A (depending on the entry standard)

SCPI command:

[<subsystem>:PRESet](#) on page 114



Save/Recall

Calls the "Save/Recall" dialog.

From the "Save/Recall" dialog the "File Select" windows for saving and recalling GNSS configurations and the "File Manager" can be called.

Configurations are stored as files with the predefined file extension `*.gps`, `*.galileo` and `*.glonass` respectively. The file name and the directory they are stored in are user-definable.

The complete settings in the dialog are saved and recalled.

"Recall GNSS setting"	<p>Opens the "File Select" window for loading a saved GNSS configuration.</p> <p>The configuration of the selected (highlighted) file is loaded by pressing the "Select" button.</p>
"Save GNSS setting"	<p>Opens the "File Select" window for saving the current GNSS signal configuration.</p> <p>The name of the file is specified in the "File name" entry field, the directory selected in the "Save into" entry field. The file is saved by pressing the "Save" button.</p> <p>The "Fast Save" checkbox determines whether the instrument performs an absolute or a differential storing of the settings. Enable this function to accelerate the saving process by saving only the settings with values different to the default ones. "Fast Save" is not affected by the "Pre-set" function.</p>
"File Manager"	<p>Calls the "File Manager".</p> <p>The "File Manager" is used to copy, delete and rename files and to create new directories.</p>

SCPI command:

`[:SOURce<hw>] :BB:GPS:SETTing:CATalog` on page 117
`[:SOURce<hw>] :BB:GALileo:SETTing:CATalog` on page 116
`<subsystem>:SETTing:STORe` on page 117
`<subsystem>:SETTing:STORe:FAST` on page 117
`<subsystem>:SETTing:LOAD` on page 117
`<subsystem>:SETTing:DELeTe` on page 118

Data List Management

Calls the "Data List Management" dialog used to create and edit a data list.



All data lists are stored as files with the predefined file extension `*.dm_iqd`. The file name and the directory they are stored in are user-definable.

Note: All data lists are generated and edited by means of the `SOURce:BB:DM` subsystem commands. Files containing data lists usually end with `*.dm_iqd`. The data lists are selected as a data source for a specific function in the individual subsystems of the digital standard.

Generate Waveform File

(R&S WinIQSIM2 only)

Calls the "Generate Waveform" menu. This menu is used to store the current GNSS signal as ARB signal in a waveform file.

The file can be loaded in the ARB menu and processed as multi carrier or multi segment signal. The file name is entered in the submenu. The file is stored with the predefined file extension *.wv. The file name and the directory it is stored in are user-definable.

See also section [chapter 2.10.2.1, "Generating an one-satellite static generic GNSS signal with R&S WinIQSIM2"](#), on page 34" and section [chapter 2.10.2.2, "Loading and Processing a GNSS Waveform in the ARB of the R&S Signal Generator"](#), on page 35.

SCPI command:

[<subsystem>:WAVEform:CREate](#) on page 119

Update RF Frequency

(R&S SMBV only)

Sets the RF Frequency level in the "Frequency" display in the header of the instrument to the resulting frequency. The RF Frequency is calculated automatically depending on the selected [RF Band](#), on the entry standard and on the enabled hybrid standards.

Note: RF Frequency vs RF Band.

- For hybrid signals with overlapping carrier frequencies, e.g. GPS and Galileo in the L1/E1 upper RNSS band (see [figure 2-1](#)), the RF frequency is the carrier frequency $L1 = E1 = 1.57542$ GHz.
- For hybrid signals with different RF Frequencies, e.g. GPS and GLONASS in the L1/E1 upper RNSS band, the resulting RF frequency is located between the GPS L1 and the GLONASS L1 frequency.

SCPI command:

[<subsystem>:PRFFrequency](#) on page 115

RF Band

Determines the RF band, i.e. the upper or lower RNSS band (see [figure 2-1](#)).

The different satellites will be modulated on their corresponding standard carrier frequencies, e.g. 1.57542 GHz for GPS and Galileo and 1.602 GHz for Glonass on the upper RNSS band (L1/E1).

Navigation Standard	"RF Band"	Carrier Frequency, GHz	Required SW Option
GPS	L1	1.57542	R&S SMBV-K44/-K244
	L2	1.2276	
GALILEO	E1	1.57542	R&S SMBV-K66/-K266
GLONASS	L1	1.602	R&S SMBV-K94/-K294
	L2	1.246	

SCPI command:

[<subsystem>:RFBand](#) on page 115

Test Scenario

(R&S SMBV instruments only)

Selects a predefined A-GPS test scenario. The available test scenarios depend on the installed SW options.

All parameters (simulated position, satellite configuration, Almanac, navigation data, etc.) will be set according to the selected test scenario.

The selection "User Defined" enables the configuration of all parameters.

Refer to [table 2-3](#) for an overview of the currently supported predefined A-GPS test scenarios.

SCPI command:

`[:SOURCE<hw>] :BB:GPS:ATSCenario` on page 115

Simulation Mode

Sets the simulation mode.

Note: Refer to [table 2-1](#) for an overview of the supported functionality per simulation mode. Some functionality require additional options.

"Static"	<p>The satellite signals are configured by the user.</p> <p>See also chapter 2.8.2, "Generating GNSS Signal for Simple Receiver Tests (Static Mode)", on page 25 for R&S SMBV instruments.</p> <p>For WinIQSIM2, see chapter 2.10.2.1, "Generating an one-satellite static generic GNSS signal with R&S WinIQSIM2", on page 34.</p>
"Auto Localization"	<p>(R&S SMBV only)</p> <p>The satellite signals are configured corresponding to a 'real' location which can be selected by the user.</p> <p>Four satellites will be selected depending on the selected almanac. For instruments equipped with option R&S SMBV-K91/-K96, the number of configurable satellites is extended to 12 resp. 24. The number of configurable satellites is adjusted with the parameter Maximum Number of Satellites.</p> <p>In this localization mode, a new satellite will be exchanged in real-time with a current one as soon as the elevation of the latter is less than the selected Elevation Mask or a new satellite constellation with better PDOP is found.</p> <p>The ephemerides are extracted from the almanac and displayed in the Navigation Message Configuration dialog. The ephemeris data of all satellites are updated automatically and projected automatically to ensure that the age of the ephemeris is within the allowed time span. Whenever a new almanac is selected, the start time of the simulation will be set to the almanac's TOA (Time of Application).</p> <p>See also chapter 2.8.3, "Generating GNSS Signal with Automatic Dynamic Exchange of the Satellites (Auto Localization Mode)", on page 25.</p>

"User Localization" (R&S SMBV only)
 User localization mode enables the configuration of the satellites constellation at the beginning of the simulation and editing it in real-time, i.e. satellites can be enabled or disabled in real-time and without interruption of the signal generation.
 For instruments equipped with assistance option (e.g. R&S SMBV-K65), this mode additionally enables the configuration of all parameter of the [Navigation Message](#), the generation of assistance data and the loading of RINEX files.
 This mode is useful for the generation of A-GPS test signals different than the standardized ones (see [chapter 2.8.5, "Generating A-GPS Custom Build Scenarios \(User Localization Mode\)"](#), on page 26).

SCPI command:

`<subsystem>:SMODE` on page 115

Oversampling

(R&S WinIQSIM2 only)

Determines the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally. This leads to limitation for the maximum [Duration Of Satellite Simulation](#).

SCPI command:

`<subsystem>:FILTer:OSAMpling` on page 118

Duration Of Satellite Simulation

(R&S WinIQSIM2 only)

Determines the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follow:

$$\text{Duration of Simulation} = \frac{\text{Duration of Satellite Simulation}}{1 + \frac{\text{Doppler Shift}}{F_{\text{Carrier}}}}$$

where F_{Carrier} is the frequency selected with the parameter ["RF Band"](#) on page 40.

The maximum duration of satellite simulation depends on the ["Oversampling"](#) on page 42 and the ARB memory size of the connected instrument.

SCPI command:

`<subsystem>:DURation` on page 118

Hybrid GNSS Configuration

(R&S SMBV only)

Opens the [Hybrid GNSS Configuration](#) dialog for enabling hybrid configuration and selecting the almanac/RINEX files per navigation standards.

If a hybrid configuration is enabled, the name of the selected GNSS navigation standard is displayed next to the button.

Trigger/Marker, Marker

Calls the menu for selecting the trigger source, for setting the time delay of an external trigger signal and for configuring the marker signals (see [chapter 3.12, "Trigger/Marker/Clock Settings"](#), on page 103). For R&S SMBV instruments, the currently selected trigger source is displayed to the right of the button.

Note: The trigger and clock functions are available for R&S SMBV instruments only.

SCPI command:

n.a.

Arm

(R&S SMBV only)

Stops signal generation. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

SCPI command:

`<subsystem>:TRIGger:ARM:EXECute` on page 204

Execute Trigger

(R&S SMBV only)

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

SCPI command:

`<subsystem>:TRIGger:EXECute` on page 205

Clock

(R&S SMBV only)

Calls the menu for selecting the clock source and for setting a delay (see [chapter 3.12, "Trigger/Marker/Clock Settings"](#), on page 103).

SCPI command:

n.a.

3.1.2 Localization Data

(R&S SMBV only)

The "Localization Data" section is where the satellites signal are configured corresponding to a 'real' "Geographic Location" which can be selected by the user.

Geographic Location

Selects the geographic location of the GPS receiver.

"User Defined" Enables the definition of the "Latitude", "Longitude" and "Altitude" of the GPS receiver with fixed position in the ECEF WGS84 coordinate system.

"Waypoints" (requires option GNSS Enhancements R&S SMBV-K92)
 Enables the selection of a moving scenario, i.e. the simulation of moving receiver. Predefined or user waypoint files can be loaded. The parameters "Latitude", "Longitude" and "Altitude" are set according to the first simulated position defined in the waypoint or NMEA file.
 For more information, see [chapter 2.6.1, "Moving Scenarios"](#), on page 21 and [chapter A, "Movement Files"](#), on page 214.
 For information about the current position of the receiver, open the [Real-Time S.P.O.T.](#) display and check the parameter "Receiver Location" or the displayed receiver trajectory ("Map View").

"City" Selects one of the predefined fixed geographic locations (see [table 3-1](#)).
 The parameters "Latitude", "Longitude" and "Altitude" are set according to the selected position.

Table 3-1: Coordinates of the Simulated Predefined Positions

Continent	City	Latitude	Longitude	Altitude
America	New York	40.7142	-74.0064	1 m
	San Francisco	37.8194388888	-122.4784944	35 m
Asia	Beijing	39.905555555555	116.391388888888	60 m
	Seoul	37.5515	126.987794444444	265 m
	Singapore	1.3113111111111	103.826852777777	110 m
	Taipei	25.022344444444	121.514758333333	10 m
	Tokyo	35.683861111111	139.745058333333	45 m
Australia	Sydney	-33.8833	151.2167	3 m
Europe	London	51.500625	-0.1246222	22 m
	Moscow	55.752222	37.615556	200 m
	Munich	48,150	11,5833	508 m
	Paris	48.8584	2.2946277777777	66 m

SCPI command:

`<subsystem>:LOCation:CATalog` on page 120

`<subsystem>:LOCation[:SElect]` on page 120

Select Waypoint File ...

This function is available only for "Geographic Location" set to Waypoints.

Calls the "Select Waypoint File" dialog to select predefined waypoint files. A waypoint file is description of a moving scenario that may have different forms, like for example a sequence of positions or vector arc movement. A waypoint file must have the extension `.txt` or `.nmea`.

See also [chapter A, "Movement Files"](#), on page 214 for detailed description of the waypoint file's format and [chapter 2.8.12, "Handling NMEA Files"](#), on page 31.

SCPI command:

`<subsystem>:LOCation:WAYPoints:FILE` on page 120

Read Out Mode

This selection is available only for "Geographic Location" set to Waypoints.

Defines the way the waypoint file is to be read.

The receiver trajectory can be observed in the "Map View" on the [Real-Time S.P.O.T.](#) display.

"Cyclic" The waypoint file is read out cyclic.
Using this read out mode is only recommended for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.

"One Way" The file is read out only once.
By reaching the end of the file, the last described position is assumed to be a static one.

"Round Trip" By reaching the end of the file, the file is read out backwards.

SCPI command:

`<subsystem>:LOCation:WAYPoints:ROMode` on page 121

Location Coordinates

In the ECEF WGS84 coordinate system, a geographic location is identified by three coordinates, the altitude, latitude and longitude. The last two can be displayed in decimal or DMS format. The display format is determined by the parameter "Position Format".

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. <ul style="list-style-type: none"> "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. <code>XX°XX'XX.XX" Direction</code>, where direction can be North/South and East/West. "Decimal Degree" The display format is decimal degree, i.e. <code>+/-XX.XXXXXX°</code>, where "+" indicates North and East and "-" indicates South and West.
"Altitude"	Sets the geographic altitude of the reference location in meters above sea level.
"Latitude"	Sets the latitude of the reference location.
"Longitude"	Sets the longitude of the reference location.

The altitude, latitude and longitude are only configurable for user defined geographic locations. If a value other than "User Defined" is selected in the "Geographic Location" field, these fields are read only.

SCPI command:

to enter the coordinates in Degree:Minute:Second format

`<subsystem>:LOCation:COORDinates:DMS` on page 122

to enter the coordinates in decimal degree format

`<subsystem>:LOCation:COORDinates:DECimal` on page 121

3.1.3 Navigation Data

The "Navigation Data" section is where the data source for navigation information is selected and the data indicated (in case of real navigation data).

Data Source

Selects data source for the navigation information.

Navigation data play an extremely important role, since they are essential for calculating the positions of the four satellites, which are the minimum prerequisite for localization purposes. It also contains the information about the currently valid space vehicle IDs.

Arbitrary data are supported only in "Static" mode. In "Auto Localization" and "User Localization" mode, "Real Navigation Data" is pre-selected and no other data source can be selected.

"Real Navigation Data" "Real Navigation Data" (almanac/RINEX) can be downloaded from the internet and stored on the hard disk of the generator. If required, re-configure manually the downloaded files.

The Galileo satellite constellation is not yet in orbit. Hence, no almanac files for Galileo are available. In the R&S SMBV, some predicted almanacs are provided to simulate the movement of Galileo satellites on their actual designed orbits.

Use the [chapter 3.2, "Hybrid GNSS Configuration"](#), on page 48 dialog to select the almanac file per navigation standard.

"PRBSxx/Data List/Pattern" Arbitrary data can be used for basic tests on the GPS signals. Data sources "PN9", "PN11", "PN15", "PN16", "PN20", "PN21", "PN23", "ALL0", "ALL1", and "Pattern" are all available. If the "Pattern" data type is used, the bit pattern is defined in the "Pattern" input box. The length is limited to 64 bits. "Data lists" are selected in the "File Select" dialog, which is called by means of the "Data List Management" button. Signals generated in this way can be recognized by a GPS receiver. However, since there are no real navigation data on the C/A code, only the signal level of the simulated satellite(s) can be measured and displayed by the receiver. A signal of this type is usually sufficient for performing simple function tests.

SCPI command:

`<subsystem>:NAVigation:DATA` on page 123

`<subsystem>:NAVigation:DATA:DSElect` on page 124

`<subsystem>:NAVigation:DATA:PATtern` on page 124

Almanac/RINEX

Opens the [Hybrid GNSS Configuration](#) dialog.

One almanac file and one RINEX file per navigation standard can be selected. The available navigation standards depend on the installed options.

Selection of RINEX files is enabled for "User Localization" mode and requires installed assistance option of the navigation standard used as an entry standard.

For description of the RINEX file format, see [chapter B, "RINEX Files"](#), on page 218.

Time Conversion Configuration

Opens the [Time Conversion Configuration](#) dialog.

System Time

Determines the time basis used to enter the simulation start time. Per default, the time basis of the entry standard is used but the user may choose or switch to a different time basis at any time. The time is then automatically recalculated and displayed in the selected time format.

Note: Use the [Time Conversion Configuration](#) dialog to configure the parameters, necessary for time conversion between the navigation's standard proprietary time and the UTC.

SCPI command:

[<subsystem>:NAVigation:SIMulation:TBASis](#) on page 125

Date [dd.mm.yyyy]

(enabled for data source "Real Navigation Data" and "System Time" set to UTC or GLO)

Enters the date for the simulation in DD.MM.YYYY format of the Gregorian calendar. The simulation time is not limited to the almanac week.

In "Auto Localization" mode, the default value of this parameter depend on the selected almanac file. The retrieved value is the week day corresponding to the TOA of the entry standard.

SCPI command:

[<subsystem>:NAVigation:SIMulation:DATE](#) on page 125

Time [hh:mm:ss:xxx]

(enabled for data source "Real Navigation Data" and "System Time" set to UTC or GLO)

Enters the exact simulation start time in UTC time format.

In "Auto Localization" mode, the default value of this parameter is equal to the [TOA](#) of the almanac that corresponds to the navigation standard used as an entry standard.

SCPI command:

[<subsystem>:NAVigation:SIMulation:TIME](#) on page 125

Week Number

(enabled for "System Time" set to GPS or GST)

Enters the week number (WN) the navigation signal is generated for.

The satellite clocks in the GPS and Galileo navigation systems are not synchronized to the UTC one but use a proprietary time, e.g. the GPS/Galileo System Time. The format used for these system time basis is week number and [Time of Week \(TOW\)](#). The weeks are numbered starting form a reference point of time (WN_REF=0), that depends on the navigation standard. For GPS, the numbering of the weeks started at January 6, 1980 (00:00:00 UTC). For GALILEO, the reference point is the August 22, 1999.

The default value of this parameter is equal to the [Week](#) of the almanac that corresponds to the navigation standard used as an entry standard.

The parameter is only available if data source "Real Navigation Data" is selected.

SCPI command:

`<subsystem>:NAVigation:SIMulation:WNUMber` on page 126

Time of Week (TOW)

(enabled for "System Time" set to GPS or GST)

Define the simulation start time within the [Week Number](#).

The Time of Week (TOW) is expressed in number of seconds and covers an entire week. The value is reset to zero at the end of each week.

SCPI command:

`<subsystem>:NAVigation:SIMulation:TOWeek` on page 126

3.1.4 Advanced Configuration

Satellite Configurations

Calls the dialog for configuring the satellite data (see [chapter 3.4, "Satellite Configuration"](#), on page 54).

Real-Time S.P.O.T.

(enabled for "Localization" mode)

Calls the dialog for real-time display of the current PDOP and HDOP values, display of the satellites states and position and display of the receiver position (see [chapter 3.11, "Real-Time S.P.O.T."](#), on page 97).

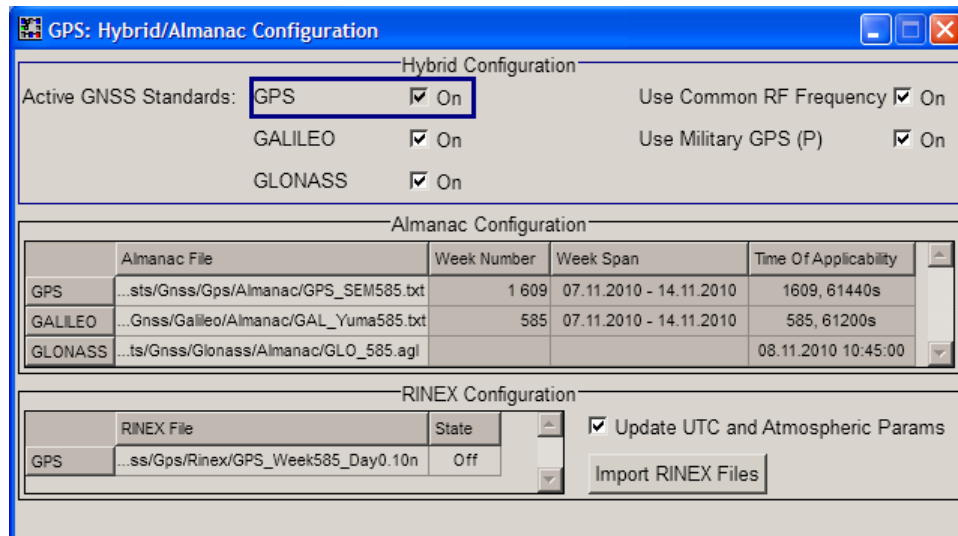
Assistance Data Generation

(enabled for "User Localization" mode and requires installed assisted option, e.g. Assisted GPS R&S SMBV-K65)

Calls the dialog [Assistance Data Generation](#) for generation of assistance data corresponding to the selected "Assistance Mode".

3.2 Hybrid GNSS Configuration

The dialog comprises the general settings for GNSS hybrid configuration, such as selecting the GNSS standards, and configuring the almanac and RINEX files.



Activate GNSS Standards

Defines the navigation standards that will be part of the hybrid configuration. Only the satellites of an enabled standard are configurable in the [Satellite Configuration](#) dialog.

The navigation standard of the entry point is always enabled. The further available navigation standards depend on the installed options.

SCPI command:

`<subsystem>:HYBRId:<GNSS>[:STATe]` on page 127

Use Common RF Frequency

Enable this parameter if several R&S SMBV instruments are connected to generate GNSS signal in the same GNSS band (see [figure 2-1](#)) and phase coherent signal is required, e.g. two instruments generating respectively up to 24 GPS and 24 GLONASS satellites in the L1/E1 RF band.

This feature triggers the instruments to shift the baseband signal in the frequency domain so that both instruments can use the same RF frequency. The effect is comparable with enabled hybrid configuration. With correct configured settings, instruments equipped with hardware option R&S SMBV-B90 generate phase coherent RF signals.

For more information on the required options, connection and configuration steps, refer to [chapter 2.9, "Generating GNSS Signal with Several Instruments \(Common RF Frequency\)"](#), on page 32.

SCPI command:

`<subsystem>:UCRF` on page 127

Use Military GPS (P)

The generation of GPS signal modulated by P code requires the additional software option R&S SMBV-K93.

This parameter is enabled only if GPS standard is activated in the hybrid configuration. Activate "Use Military GPS (P)" to enable the selection of P and C/A+P signals in the [Satellite Configuration](#) dialog.

SCPI command:

`<subsystem>:UMGPS` on page 127

Almanac Configuration

Displays the settings of the selected almanac files per navigation standard. One almanac file can be selected per navigation standard. Predefined or user almanac files can be loaded.

The following almanac files are supported:

- **GPS and Galileo**
 - SEM-files with data extension `xxx.al3`
 - YUMA almanac files with data extension `xxx.alm`

These files describe GPS and Galileo almanacs, whereas xxx denotes the day of a year.

Note: Current GPS almanac data can be downloaded via the Internet and stored on the hard disk of the instrument:

U.S.Coast Guard Navigation Center GPS Homepage <http://www.navcen.uscg.gov/GPS/almanacs.htm>

- **Glomass**

Almanac files with data extension `xxx.ag1`

Refer also to the download ftp site for Glonass almanacs: <ftp://ftp.glonass-iac.ru/MCC/ALMANAC/>

When an almanac file is selected, the time information of the file (Week, SEM and TOA) is indicated in the table. If RINEX file is not enabled, the satellite specific information (ephemeris) is also taken from the almanac.

The SEM and TOA are indicated in Greenwich Mean Time.

Parameter	SCPI command
"Almanac File"	<code><subsystem>:NAVigation:ALManac:<GNSS>:FILE</code> on page 130 <code><subsystem>:SVID:<GNSS>:LIST</code> on page 134
"Week Number" ¹⁾	<code><subsystem>:NAVigation:ALManac:<GNSS>:WNUMBER</code> on page 132
"Week Span" ¹⁾	<code><subsystem>:NAVigation:ALManac:<GNSS>:DATE:BEGIN</code> on page 129 <code><subsystem>:NAVigation:ALManac:<GNSS>:DATE:END</code> on page 130
"Time of Applicability (TOA)" ²⁾	<code><subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:TOWeek</code> on page 132 <code><subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:WNUMBER</code> on page 132
"Time of Applicability (TOA)"	<code><subsystem>:NAVigation:ALManac:GLONass:TOApplicability:DATE</code> on page 130 <code><subsystem>:NAVigation:ALManac:GLONass:TOApplicability:TIME</code> on page 131

¹⁾ "Week Number" and "Week Span": no SCPI command for Glonass

²⁾ TOA format for GPS: $(WN, TOW) WN_REF$ (6 Jan 1980 00:00:00 UTC)

TOA format for Galileo: $(WN, TOW) WN_REF$ (22 August 1999 00:00:00 UTC)

RINEX Configuration

Selects and activates one "RINEX File" per navigation standard. Predefined or user RINEX files can be loaded. Perform "Import RINEX Files" to upload the selected file. The parameters of the SV IDs included in the selected RINEX file are retrieved from this file. However, the parameters of SV IDs that are manually added to the satellites constellation are retrieved from the selected almanac.

Enable the "Update UTC and Atmospheric Parameters" to synchronizes the [time conversion parameters](#) and the atmospheric parameters to the corresponding values retrieved from the RINEX file.

See [chapter B, "RINEX Files"](#), on page 218 for description of the RINEX file format.

See also [chapter 2.8.10, "Configuring the Navigation Parameters"](#), on page 29.

SCPI command:

`<subsystem>:NAVigation:RINex:GPS:FILE` on page 133

`<subsystem>:NAVigation:RINex:GPS:STATE` on page 133

`<subsystem>:NAVigation:RINex:IMPort` on page 133

`<subsystem>:NAVigation:RINex:UUAState` on page 133

`<subsystem>:NAVigation:RINex:UFNState` on page 134

3.3 Time Conversion Configuration

This dialog provides the settings necessary to configure the time conversion from a navigation standard (GPS, Galileo or GLONASS) to UTC. The conversion settings are necessary for switching from one time basis to another.

The time conversion is performed according to the following formula:

$t_{UTC} = (t_E - \text{delta_}t_{UTC}) \text{ modulo } 86400$, where $\text{delta_}t_{UTC}$ and t_E are as follows:

$\text{delta_}t_{UTC} = \text{delta_}t_{LS} + A_0 + A_1 (t_E - T_{ot} + 604800(WN - WN_{ot}))$ and

$t_E = t_{GPS}$ or $t_{Galileo}$

Time Conversion Parameters			
	GPS-UTC	GALILEO-UTC	GLONASS-(UTC(SU)+3h)
A_0	0	0	0
Scale Factor	2^{-30}	2^{-30}	2^{-31}
Scaled Value	0.000000e+00	0.000000e+00	0.000000e+00
A_1	0	0	
Scale Factor	2^{-50}	2^{-50}	
Scaled Value	0.000000e+00	0.000000e+00	
T_ot	21	0	
Scale Factor	2^{12}	3600	
Scaled Value	8.640000e+04	0.000000e+00	
WN_ot	1 610	0	

Leap Second Configuration

Synchronize

Current Leap Seconds: 15

Simulate Leap Second Transition: On

Next Leap Second Date: 08.11.2010

Leap Sign: +1

UTC - UTC(SU)

UTC(SU) Reference Date: 08.11.2010

A_0: x 2^{-10} = 0.002 0 s

A_1: x 2^{-16} = 0.000 000s/msd



The GNSS implementation in the R&S WinIQSIM2 is a simplified offline version of the real-time one and provides the capability to generate an one-satellite generic signal. Therefore the time conversion parameters table is adjusted accordingly to one satellite in R&S WinIQSIM2. You find the differences explicitly stated in the description.

Time Conversion Parameters

Configuration of the time conversion parameters require software option R&S SMBV-K92. The time conversion parameters are enabled only in "User Localization" and "Static" modes.

The basis for the time conversion is the UTC. The parameters of each of the navigation standards are set as an offset to the UTC.

To retrieve the time configuration parameters from an imported RINEX file, enable the parameter [Update UTC and Atmospheric Parameters](#).

For better readability, the values of the time correction parameters are input as integer in the same way as they are included in the satellite's navigation message but the corresponding "Scale Factor" and the "Scaled Value" are displayed too.

Parameter	Description	SCPI Command
"A_0"	Constant term of polynomial, A_0	<subsystem>:NAVigation:TCONversion: GPS:AZERO on page 135
"A_1"	1 st order term of polynomial, A_1	<subsystem>:NAVigation:TCONversion: GPS:AONE on page 135
"t_ot"	UTC data reference Time of Week, t_{ot}	<subsystem>:NAVigation:TCONversion: GPS:TOT on page 136
"WN_t"	UTC data reference Week Number, WN_t	<subsystem>:NAVigation:TCONversion: GPS:WNOT on page 136

Leap Second Configuration

The GPS time is not corrected to match the Earth's rotation and does not consider time corrections that are typical for the UTC, such as the leap second for instance. The UTC time corrections are performed periodically, the date of the next expected correction is determined by the parameter "Next Leap Second Date".

As of 2010, the value of the "Current Leap Second", is 15 seconds.

Parameter	Description	SCPI Command
"Synchronize"	Synchronizes the leap second according to the simulation time.	<subsystem>:NAVigation:TCONversion: LEAP:SYNC on page 138
"Current Leap Seconds"	Displays the currently used leap second.	<subsystem>:NAVigation:TCONversion: LEAP:SECONDS on page 138
"Simulate Leap Second Transition"	Enables/disables the simulation of the leap second transition.	<subsystem>:NAVigation:TCONversion: LEAP:SLSTransition[:STATE] on page 137
"Next Leap Second Date"	Determines the date of the next UTC time correction.	<subsystem>:NAVigation:TCONversion: LEAP:DATE on page 137
"Leap Sign"	The time correction is performed in steps of one second. One second may be added to or subtracted from the current leap second value.	<subsystem>:NAVigation:TCONversion: LEAP:SIGN on page 138

UTC-UTC(SU)

(for GLONASS satellites)

The Universal Time Coordinate (UTC) as used for GPS and Galileo can have a phase shift and a frequency drift compared to the Russian UTC basis (UTC(SU)). These settings are provided for configuration of the UTC differences UTC - UTC(SU) as transmitted by GLONASS satellites.

Parameter	Description	SCPI Command
"UTC(SU) Reference Date"	Indicates the UTC-UTC (SU) time conversion reference date.	<subsystem>:NAVigation:TCONversion:UTCSu:DATE on page 137
"A_0"	Constant term of polynomial A ₀ (virtual)	<subsystem>:NAVigation:TCONversion:UTCSu:AZERo on page 137
"A_1"	1 st order term of polynomial, A ₁ (virtual)	<subsystem>:NAVigation:TCONversion:UTCSu:AONE on page 136

The Glonass satellites transmit the offset between GPS and GLONASS system time as part of their navigation message. They assume only a delay and no frequency drift. The time offset is calculated as following:

$$\text{GPS} - \text{GLONASS} = \text{"GPS} - \text{UTC"} + \text{"UTC} - \text{UTC (SU)"} - \text{"GLONASS} - (\text{UTC (SU)} + 3\text{h)"} - 3\text{h}$$

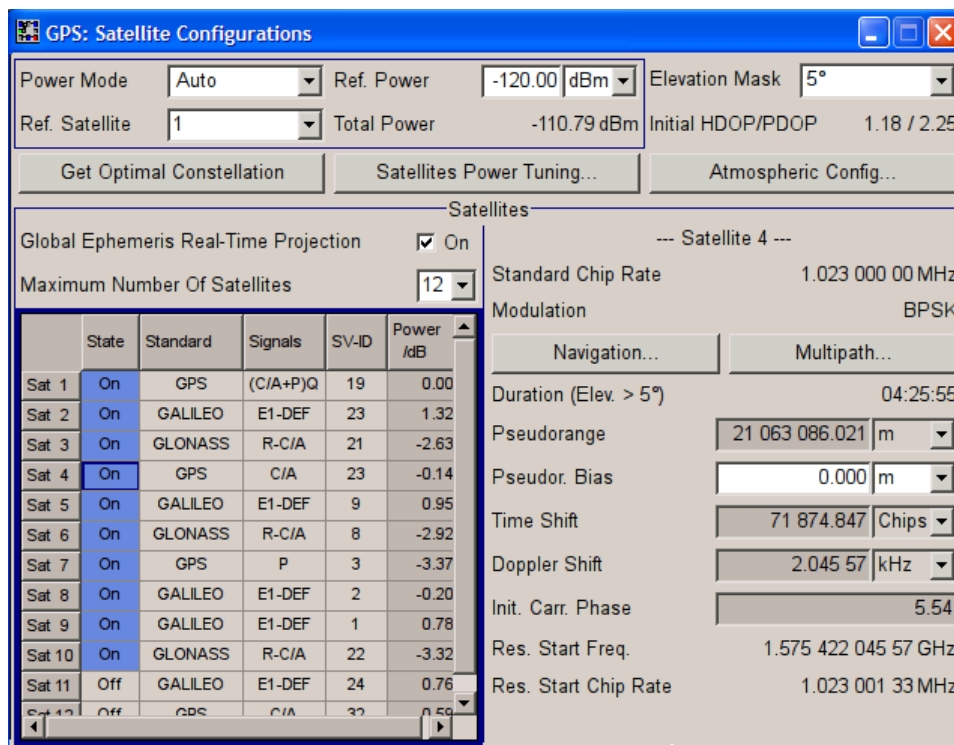
For hybrid configuration with activated GLONASS satellites, this GPS – GLONASS time offset is maintained constant by automatically adjusting the "GPS-UTC" drift parameters ("A_1", "T_ot" and "WN_ot") while changing the "UTC – UTC(SU)" parameters.

3.4 Satellite Configuration

In the "Satellite Configuration" dialog, the signal simulation of up to 24 satellites can be activated and configured. The maximum number of the configurable satellites depends on the installed options.

The GNSS implementation in R&S WinIQSIM2 is a simplified offline version of the real-time option. The offline version provides the possibility to generate an one-satellite generic signal, i.e. only 1 satellite can be activated and configured.

In the following description, the relevant parameters are adjusted accordingly in R&S WinIQSIM2. You find the differences explicitly stated in the description.



3.4.1 Power Configuration



The power settings in the upper part of the dialog are relevant only for R&S SMBV instruments. Section "Satellites" applies also to WiniWQSIM, however, only one satellite can be configured.

This section comprises the power settings. The dynamic power control concept is based on two power modes, the "Auto" and the "User" mode. Use the auto mode if a dynamic automatic power calculation is preferred. For flexible real time configuration of the power settings per satellite, enable the user mode.

The [table 3-2](#) gives an overview of the parameters that are considered by the calculation of the satellites' power levels.

Table 3-2: Overview of the parameters affecting the power level of the GNSS signal

Power Mode	Reference Power	Reference Satellite	Pseudorange	Inter-Standard Tuning	Additional Power per Tap	Relative/Displayed Power of the individual satellites signal component
Auto	yes	yes	yes	yes	yes	displays the power level at the simulation start time
User	yes	-	-	-	yes	yes

The [table 3-3](#) shows how the power levels are calculated depending on the "Simulation Mode", the "Power Mode" and whether a signal component undergoes multipath or not.

Table 3-3: Calculating the power levels of the satellite as a function of the "Power Mode" and the "Simulation Mode".

Power Mode/ Simulation Mode	Auto	User
"Static"	-	Absolute Power _{Sat#_Signal} = Ref. Power + Relative Power _{Sat#_Signal}
"Auto Localization"	Absolute Power _{Sat#_Signal} = Ref. Power + Power* _{Sat#_Signal} ¹⁾	-
"User Localization"	Absolute Power _{Sat#_Signal, Tap#} = Ref. Power + Power* _{Sat#_Signal} ¹⁾ + Additional Power _{Tap#}	Absolute Power _{Sat#_Signal, Tap#} = Ref. Power + Power _{Sat#_Signal} + Additional Power _{Tap#}

¹⁾ Power*_{Sat#_Signal_t} = $20\log_{10}(\text{Pseudorange}_{\text{Ref.Sat}_t0} / \text{Pseudorange}_{\text{Sat\#Signal}_t})$ + Inter-Standard Power_{Sat#_Ref.Sat}, where t_0 represents the start moment of the simulation.



The power level displayed in the user interface represents the power level at the start moment of the simulation (t_0) and is calculated as follow:

Displayed Power_{Sat#_Signal_t0} = $20\log_{10}(\text{Pseudorange}_{\text{Ref.Sat}_t0} / \text{Pseudorange}_{\text{Sat\#Signal}_t0})$ + Inter-Standard Power_{Sat#_Ref.Sat}



The total power of the generated GNSS signal is displayed with the parameter **Total Power**.

Example: Power calculation in "User" power mode for GNSS signal undergoing multipath propagation

Power calculation for the power settings and Satellite Constellation as shown on [figure 3-1](#).

Maximum Number Of Satellites					
	State	Standard	Signals	SV-ID	Power /dB
Sat 1	On	GPS	C/A	6	-1.00
Sat 2	On	GPS	C/A	16	0.00
Sat 3	On	GALILEO	E1-DEF	14	-5.00
Sat 4	On	GALILEO	E1-DEF	17	-10.00

Fig. 3-1: Example: Power Configuration in User Power Mode

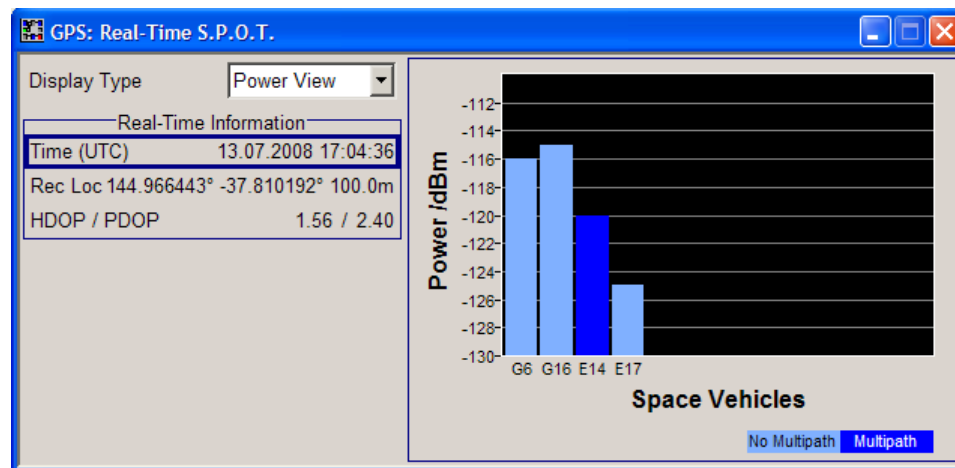
- Number of Satellites = 4
- Sat#1: Power_{Sat#1_C/A} = -1 dB; Multipath = Off
- Sat#2: Power_{Sat#2_C/A} = 0 dB; Multipath = Off
- Sat#3: Power_{Sat#3_E1-DEF} = -5 dB; Multipath = On (Additional Power_{Tap#1} = -5 dB, Additional Power_{Tap#2} = -3 dB)
- Sat#4: Power_{Sat#4_E1-DEF} = -10 dB; Multipath = Off
- Reference Power = -115 dBm

Calculation of the absolute power levels

- Absolute Power_{Sat#1_C/A} = Ref. Power + Power_{Sat#1_C/A} + Additional Power_{tap#} = -115 dBm + -1 dB = -116 dBm
- Absolute Power_{Sat#2_C/A} = Ref. Power + Power_{Sat#2_E1-DEF} + Additional Power_{tap#} = -115 dBm + 0 dB = -115 dBm
- Absolute Power_{Sat#3_E1-DEF, Tap#1} = Ref. Power + Power_{Sat#3_E1-DEF} + Additional Power_{Tap#1} = -115 dBm + -5 dB + -5 dB = -125 dBm
 Absolute Power_{Sat#3_E1-DEF, Tap#2} = Ref. Power + Power_{Sat#3_E1-DEF} + Additional Power_{Tap#2} = -115 dBm + -5 dB + -3 dB = -123 dBm
- Absolute Power_{Sat#4_E1-DEF} = Ref. Power + Power_{Sat#4_C/A} + Additional Power_{tap#} = -115 dBm + -10 dB = -125 dBm



Open the "Real-Time SPOT" dialog, set the "Display Type" to "Power View" and compare the displayed power levels.



The power level are displayed sorted per navigation standard and in ascending order of the SV-ID.

Example: Power calculation in "Auto" power mode

Power calculation for the power settings and Satellite Constellation at the simulation start time as shown on [figure 3-2](#).

Maximum Number Of Satellites: 4					
	State	Standard	Signals	SV-ID	Power /dB
Sat 1	On	GPS	C/A	6	0.50
Sat 2	On	GPS	C/A	16	0.00
Sat 3	On	GALILEO	E1-DEF	14	-0.63
Sat 4	On	GALILEO	E1-DEF	17	-0.61

Fig. 3-2: Example: Power Configuration in Auto Power Mode

Note: The power values displayed in "Auto" power mode correspond to the start of the simulation ($t=0$). The power levels change automatically as function of the satellite-receiver distance but the display is not updated.

Tip: Open the "Real-Time SPOT" dialog and set the "Display Type" to "Power View". The displayed power levels are updated in real-time.

Power levels at the beginning of the simulation ($t=t_0$):

- Reference Power = -115 dBm
The Reference Power is the nominal power of the Reference Satellite at the start time and location; the power of all other satellites are simulated as relative power to the power of the reference one.
- Reference Satellite = Sat#2
- Number of Satellites = 4
- Sat#1: Displayed Power $_{\text{Sat\#1_C/A}}$ = 0.5 dB; Multipath = Off
- Sat#2: Displayed Power $_{\text{Sat\#2_E1-DEF}}$ = 0 dB; Multipath = Off; Pseudorange $_{\text{Ref.Sat_t0}}$ = 23230064.433 m
- Sat#3: Displayed Power $_{\text{Sat\#2_E1-DEF}}$ = -0.63 dB; Multipath = Off
- Sat#4: Displayed Power $_{\text{Sat\#4_C/A}}$ = -0.61 dB; Multipath = Off
- Inter-Standard Power Tuning $_{\text{GPS C/A-GAL E1-DEF}}$ = -1.5 dB , i.e. the Displayed Power levels of the Galileo satellites are internally boosted with 1.5 dB.

Calculation of the absolute power levels at the beginning of the simulation ($t=t_0$):

- Absolute Power $_{\text{Sat\#1_C/A}}$ = Ref. Power + Displayed Power $_{\text{Sat\#1_C/A}}$ = -115 dBm + 0.5dB = -114.5 dBm
- Absolute Power $_{\text{Sat\#2_C/A}}$ = Ref. Power = -115 dBm
- Absolute Power $_{\text{Sat\#3_E1-DEF}}$ = Ref. Power + Displayed Power $_{\text{Sat\#3_E1-DEF}}$ = -115 dBm + -0.63 dB = -115.63 dB
- Absolute Power $_{\text{Sat\#4_E1-DEF}}$ = Ref. Power + Displayed Power $_{\text{Sat\#4_C/A}}$ = -115 dB + -0.61 dB = -115.61 dB



Open the "Real-Time SPOT" dialog, set the "Display Type" to "Power View" and compare the displayed power levels.

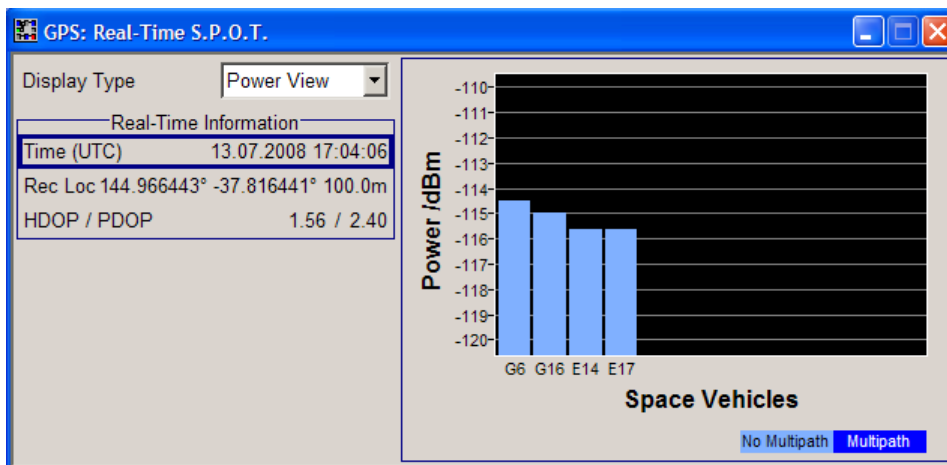


Fig. 3-3: Example: Power levels at the beginning of the simulation

Another way to query the current power levels is by using the corresponding SCPI command, e.g. see `<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute` on page 194.



The total power of the generated GNSS signal is displayed with the parameter "Total Power".

Example: Power calculation for mixed signals

Power calculation for the power settings and Satellite Constellation at the simulation start time as shown on figure 3-4.

Maximum Number Of Satellites: 4

	State	Standard	Signals	SV-ID	Power /dB
Sat 1	On	GPS	(C/A+P)Q	28	-1.31
Sat 2	On	GALILEO	E1-DEF	21	0.00
Sat 3	On	GLONASS	R-C/A	1	-5.39
Sat 4	On	GPS	C/A	4	-2.14

Fig. 3-4: Example: Power Configuration with Mixed Signal

This example focus only on the power calculation of the mixed signal.

- Power Mode = User
Number of Satellites = 4
for all satellites Multipath = Off
- Sat#1: $Power_{Sat\#1_C/A+P} = -1.31$ dB; Power Reference = C/A; Intra-Standard $Power_{Sat\#_PowRef} = 3$ dB, i.e the civilian is boosted with 3 dB compared to the military signal.

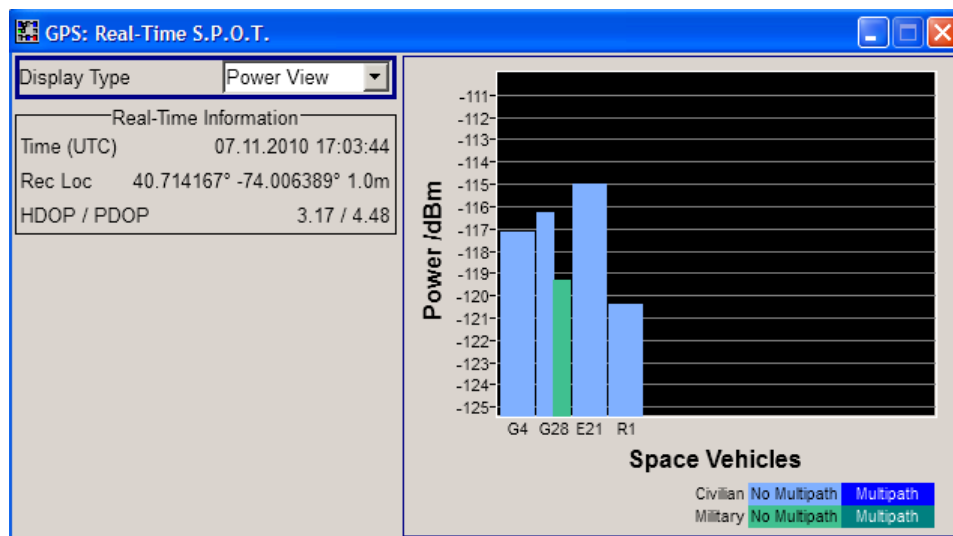
- Sat#2: $\text{Power}_{\text{Sat\#2_E1-DEF}} = 0 \text{ dB}$; $\text{Pseudorange}_{\text{Ref.Sat_t0}} = 23384433.474 \text{ m}$
- Sat#3: $\text{Power}_{\text{Sat\#3_R-C/A}} = -5.39 \text{ dB}$;
- Sat#4: $\text{Power}_{\text{Sat\#4_C/A}} = -2.14 \text{ dB}$;
- Reference Power = -115 dBm

Calculation of the absolute power levels

- Absolute Power $\text{Power}_{\text{Sat\#1_C/A}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#1_C/A+P}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + -1.31 \text{ dB} = -116.31 \text{ dBm}$
 Absolute Power $\text{Power}_{\text{Sat\#1_P}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#1_C/A+P}} + \text{Additional Power}_{\text{tap\#}} + \text{Intra-Standard Power}_{\text{Sat\#_PowRef}} = -115 \text{ dBm} + -1.31 \text{ dB} + -3 \text{ dB} = -119.31 \text{ dBm}$
- Absolute Power $\text{Power}_{\text{Sat\#2_E1-DEF}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#2_E1-DEF}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + 0 \text{ dB} = -115 \text{ dBm}$
- Absolute Power $\text{Power}_{\text{Sat\#3_R-C/A}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#3_R-C/A}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + -5.39 \text{ dB} = -120.39 \text{ dBm}$
- Absolute Power $\text{Power}_{\text{Sat\#4_C/A}} = \text{Ref. Power} + \text{Power}_{\text{Sat\#4_C/A}} + \text{Additional Power}_{\text{tap\#}} = -115 \text{ dBm} + -2.14 \text{ dB} = -117.14 \text{ dBm}$



Open the "Real-Time SPOT" dialog, set the "Display Type" to "Power View" and compare the displayed power levels.



The power level are displayed sorted per navigation standard and in ascending order of the SV-ID.

Power Mode

Determines whether the power is calculated automatically or is based on user defined settings.

- "User" power mode is intended for dynamical configuration of the power of each satellite separately and manually.
 The "User" power mode is enabled in "User Localization" and "Static" modes.

- "Auto" power mode enables an internal dynamical automatic power control. The power of all satellites is calculated automatically based on the satellite-to-receiver distance and relative to the relative power of the reference satellite. The Reference Satellite is simulated as relative 0 dB at the start reference receiver location and at the simulation start time.
The "Auto" power mode is enabled in "Auto Localization" and "User Localization" modes.

SCPI command:

`<subsystem>:POWER:MODE` on page 153

Reference Power

Sets the power level that is used as a reference for the calculation of the power level of the satellites.

- In "Auto" power mode, the "Reference Power" is the power level of the reference signal component on the [Reference Satellite](#) at the start simulation time and at the start location.
The "Inter-Standard Power Tuning" settings are applied automatically. The power level of all other satellites are calculated automatically based on this reference power level for each moment of time depending on the ratio of their dynamic satellite-receiver distance.
- In "User" power mode, the "Reference Power" represents the power level based on which all initial satellite power levels are calculated.

SCPI command:

`<subsystem>:POWER:REference` on page 153

Reference Satellite

Determines the satellite used as a reference for the calculation of the power levels of the satellites in "Auto" power mode. The power level of this satellite is set to the [Reference Power](#).

SCPI command:

`<subsystem>:POWER:SREference` on page 154

Total Power

By enabled signal generation, displays the total power of the generated GNSS signal at a moment of time. The total power is a real time parameter that follows the real time changes in the absolute power levels of all active satellites.

SCPI command:

`<subsystem>:POWER:TOTal` on page 154

3.4.2 General Satellites Settings

Use Spreading

(enabled in "Static" mode only)

Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

SCPI command:

[<subsystem>:SPReading\[:STATe\]](#) on page 144

Galileo Sat. Modulation

(Galileo in WinIQSIM2 only)

Selects the modulation mode used for modulating the Galileo carrier signal.

Tip: Select BOC(1,1) modulation to reduce the sample rate required to simulate a certain period of time.

SCPI command:

[<subsystem>:GALModulation](#) on page 145

Elevation Mask

(R&S SMBV instruments only)

(enabled for "Auto Localization" and "User Localization" mode)

Sets the satellite's elevation mask, i.e. determines the elevation filter applied during the "Get Optimal Constellation" process or, while using the Auto Localization mode, used to filter all low-elevation satellites which are closer to the horizon and may witness in reality more unwanted multipath effects.

When the elevation decreases below the selected elevation mask, the GPS satellite is considered as invisible by the receiver and hence the GPS receiver can not use this satellite for determining its position. The GPS receiver has to search for another satellite with better visibility.

Automatic dynamic exchange of the satellites is performed in "Auto Localization" only. The expected time of the next upcoming satellites handover is displayed in the "Real-Time S.P.O.T." view with the parameter [Get Next Handover Time](#).

While analyzing the generated signal, make sure that the "Satellite Elevation Mask" used by the signal generation is set to the elevation mask of the GPS receiver.

SCPI command:

[<subsystem>:SEMask](#) on page 144

Initial HDOP/PDOP

(R&S SMBV only)

Displays the HDOP (Horizontal Dilution of Precision) / PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

The displayed HDOP/PDOP value is not updated. The dynamic "HDOP" and "PDOP" calculated on the current satellite constellation is displayed in the [Real-Time S.P.O.T.](#) dialog.

The HDOP can be used as an indication of 2D positioning quality; the PDOP is an indication of 3D positioning quality. The general rule here is that the smaller the HDOP/PDOP the better the precision of the position fix will be.

At least four different satellites have to be configured to get a reasonable value; otherwise -1 will be displayed.

This parameter is enabled only for "Auto Localization" and "User Localization" mode.

SCPI command:

`<subsystem>:HDOP` on page 144

`<subsystem>:PDOP` on page 145

Atmospheric Configuration

(R&S SMBV only)

Opens the [Atmospheric Configuration](#) dialog for configuring the ionospheric model and parameters and the tropospheric parameters per navigation standard.

Get Optimal Constellation

(R&S SMBV only)

In "User Localization" mode, the satellites are fully configurable. Use this function prior to and as basis for further configurations and retrieve an optimal satellites constellation for the selected Almanac/RINEX file, [Elevation Mask](#) and the selected [Maximum Number of Satellites](#).

Note: The retrieved satellite's constellation includes satellites with "State Off", if the number of satellites with elevation higher than the selected "Elevation Mask" is less than the selected "Maximum Number of Satellites".

SCPI command:

`<subsystem>:GOConstellation` on page 145

`<subsystem>:RT:OCONstellation` on page 200

Satellites Power Tuning

(R&S SMBV only)

Opens the [Satellites Power Tuning](#) dialog for setting the power relation between the signals of different GNSS standards.

Global Signal Configuration

Enabled in "Auto Localization" mode.

Opens the [Global Signal Configurations](#) dialog to determine the type of signal a SV ID will use in the moment the corresponding satellite becomes visible.

3.4.3 Configuration of the Satellite Constellation

This section comprises the setting of the satellites constellation and the individual settings of each enabled satellite. The satellite constellation is enabled for configuration in "Static" and "User Localization" mode.

Global Ephemeris Real-Time Projection

(R&S SMBV only)

Forces ephemeris projection for all satellites, i.e. enables the parameter "Sat# > Navigation Message Configuration > [Real-Time Projection](#)" for all satellites.

Note: "Global Ephemeris Real-Time Projection" has to be disabled, if assistance data will be generated.

SCPI command:

[<subsystem>:SATellite:GRTProjection](#) on page 146

Maximum Number of Satellites

Determines the maximum number of satellites that can be simulated. The minimum allowed values depends on the selected [Simulation Mode](#). Configurations with one satellite are allowed only in "Static" mode; "Auto Localization" and "User Localization" modes require four satellites or more.

Generating the navigation signal with more than 6 satellites is enabled only for instruments, equipped with option R&S SMBV-K91/-K96. The maximum number of satellites is additionally limited by the available hardware resources of the instrument, especially if P-Codes are used in hybrid configurations. Refer to [chapter 2.4.1, "Channel Budget"](#), on page 18 and [chapter 2.5, "Realtime Option Extension to 24 Satellites \(R&S SMBV-K96\)"](#), on page 20 for detailed description.

The GNSS implementation in the R&S WiniQSIM2 provides to generate only one satellite signal.

The number of satellites selected determines the number of rows in the [Constellation Table](#).

SCPI command:

[<subsystem>:SATellite:COUNT](#) on page 146

Constellation Table

Comprises the setting of the satellites constellation. These settings are enabled for configuration in "Static" and "User Localization" mode.

Satellite State ← Constellation Table

Activates/deactivates the satellite.

Note: In "User Localization" mode, changing the satellites state is performed **on-the-fly** and without interruption of the signal generation.

Note: Not enough hardware resources. This error message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid configurations, multipath configurations, signals modulated by P code and activated satellites consume hardware resources. Refer to [chapter 2.4.1, "Channel Budget"](#), on page 18 for description on the how the available hardware resources are distributed.

SCPI command:

[<subsystem>:SATellite<st>:STATe](#) on page 150

Standard ← Constellation Table

Selects the navigation standard the corresponding satellite belongs to. The available GNSS standards depend on the entry standard, the selected [Hybrid GNSS Configuration](#) and the installed options.

SCPI command:

`<subsystem>:SATellite<st>:STANdard` on page 150

Signal(s) ← Constellation Table

Selects the type of signal the corresponding satellite is using.

According to the GPS specifications, the C/A code ($f_{ca} = 1.023$ MHz) is provided for civilian purposes. They are used as spreading codes for the navigation data which is transmitted at a rate of 50 baud. The carrier L1 or L2 signal can be modulated by C/A code only, P code only or by both (C/A+P). The modulation used is displayed with the parameter [Modulation](#).

Note: The generation of GPS signal modulated by P code requires the additional software option R&S SMBV-K93. The configuration of "P" and "C/A+P" signals is enabled only for enabled hybrid configuration with GPS navigation standard and activated "Hybrid Configuration > Use Military GPS (P) > On".

Table 3-4: Overview of the supported signals

Band	Entry Point	Standard	Signal	minimum Required Option
L1/E1	GPS	GPS	C/A P (C/A+P)Q ¹⁾ (C/A+P)I ¹⁾	R&S SMBV-K44, R&S SMBV-K244 R&S SMBV-K93
	Galileo	Galileo	E1-DEF	R&S SMBV-K66, R&S SMBV-K266
	GLONASS	GLONASS	R-C/A	R&S SMBV-K94, R&S SMBV-K294
L2	GPS	GPS	C/A P (C/A+P)Q ¹⁾ (C/A+P)I ¹⁾	R&S SMBV-K44, R&S SMBV-K244 R&S SMBV-K93
	GLONASS	GLONASS	R-C/A	R&S SMBV-K94, R&S SMBV-K294

¹⁾(C/A + P)Q is the standard transmitted signal on L1 and L2 with C/A lagging P by 90° phase shift; old generation IIA satellites did not transmit P on L2. The standard mentions some cases where C/A and P are in-phase on L2 and hence the availability of the configuration (C/A+P)I.

Note: Not enough hardware resources. This error message appears and the satellite is disabled if the available hardware resources are not enough to generate the desired signal.

Hybrid configurations, multipath configurations, signals modulated by P code and activated satellites consume hardware resources. Refer to [chapter 2.4.1, "Channel Budget"](#), on page 18 for description on the how the available hardware resources are distributed.

SCPI command:

`<subsystem>:SATellite<st>:SIGNal` on page 150

SV-ID ← Constellation Table

Enters the Space Vehicle ID of the satellite to be simulated. This value is used to generate the corresponding spreading code.

Note: The SV ID of the GLONASS satellites are with 64 smaller than their PRN number, e.g. to GLONASS satellite R5 corresponds PRN=69.

If "Real Navigation Data" is used, only the valid IDs which are listed in the almanac are selectable; for arbitrary data, any ID can be selected.

SV ID set to "N.A." indicates a not assigned satellite.

The SV-ID field is highlighted in dark blue color if multipath is activated.

SCPI command:

`<subsystem>:SATellite<st>:SVID` on page 150

Power ← Constellation Table

(R&S SMBV instruments only)

The meaning of this parameter depends on the selected "Power Mode":

- In "User" power mode, this parameter sets the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites. Configuration of satellites power is performed **on-the-fly** and without interruption of the signal generation.
- In "Auto" power mode, the displayed value is the power level of the satellite at the start of the simulation (t_0). A configured [Inter-Standard Tuning](#) is automatically applied. The power level changes automatically as function of the satellite-receiver distance ([Pseudorange](#)) but the display is not updated. The power is calculated as follow:

$$\text{Power}_{\text{Sat\#_Signal_t}}^* = 20 \log_{10}(\text{Pseudorange}_{\text{Ref.Sat_t0}} / \text{Pseudorange}_{\text{Sat\#Signal_t}}) + \text{Inter-Standard Power}_{\text{Sat\#_Ref.Sat}}$$

where t_0 represents the start moment of the simulation.

The displayed power in "Auto" power mode is then:

$$\text{Displayed Power}_{\text{Sat\#_Signal_t0}} = 20 \log_{10}(\text{Pseudorange}_{\text{Ref.Sat_t0}} / \text{Pseudorange}_{\text{Sat\#Signal_t0}}) + \text{Inter-Standard Power}_{\text{Sat\#_Ref.Sat}}$$

For the Reference Satellite, the Inter-Standard Power is always 0 dB. For the simulation start time ($t=t_0$), the Displayed Power is also 0 dB, because:

$$\text{Displayed Power}_{\text{RefSat\#_Sig_t0}} = 20 \log_{10}(\text{Pseudorange}_{\text{Ref.Sat_t0}} / \text{Pseudorange}_{\text{Ref.Sat_t0}}) + \text{Inter-Standard Power}_{\text{Ref.Sat_Ref.Sat}} = 20 \log_{10} 1 + 0 \text{ dB} = 0 \text{ dB}$$

See also [chapter 3.4.1, "Power Configuration"](#), on page 55 for information about the power calculation.

SCPI command:

`<subsystem>:SATellite<st>:POWER` on page 154

`<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute` on page 194

3.4.4 Individual Satellite Settings

Comprises the settings of the selected satellite.



The values displayed in this section are the initial values of the parameters at the beginning of the simulation or at the time the specific satellite is activated. These values will be updated internally to implement moving satellites and receivers. However the displayed values are not updated.

Standard Chip Rate

Displays the chip rate.

SCPI command:

`<subsystem>:SATellite<st>:SCRate` on page 149

Frequency Number

(enabled for GLONASS satellites only)

Frequency number indicates the sub-carrier used to modulate the GLONASS satellite.

Depending on the selected [Data Source](#), "Frequency Number" is either configurable or read only. If the frequency number is read directly from the Almanac file, i.e. if you use "Real Navigation Data" as data source, frequency number is read only. With "Pattern", "PRBS" or "Data List", you can set the value.

SCPI command:

`<subsystem>:SATellite<st>:FNUMber` on page 147

Modulation

Displays the modulation used for modulating the carrier signal.

SCPI command:

`<subsystem>:SATellite<st>:MODulation` on page 148

Power Reference

For mixed [Signal\(s\)](#) like "C/A+P", displays the signal used as a reference by power calculation.

The power reference is fixed to "C/A" for mixed signals. For signals modulated only with the P code, the power reference is "P".

SCPI command:

`<subsystem>:SATellite<st>:POWer:RSIGnal` on page 154

Navigation...

Opens the [chapter 3.8, "Navigation Message Configuration"](#), on page 75 dialog for configuring the parameters of the navigation message.

Multipath...

(requires option R&S SMBV-K92)

Opens the [Multipath Configuration](#) dialog for configuring the multipath propagation per satellite.

Duration (Elev. > 2.5/5/7.5/10°)

(R&S SMBV only)

This parameter is enabled only for "Localization" mode.

Displays the time the satellite's elevation will be higher than 2.5, 5, 7.5 or 10° starting at the first simulation moment of the satellite of interest, as selected with the parameter [Elevation Mask](#). This parameter can be used to get an impression of how long the connected GPS receiver may use this certain satellite for its position fix.

The value is displayed in format hh:mm:ss.

The displayed value is not updated but the elevation of each satellite is constantly monitored. Decreasing the satellite's elevation below the selected elevation mask value is one of the reasons for the automatic dynamic exchange of satellites. Thus, a change of the satellite constellation can occur before the initially calculated time elapses.

In "Auto Localization" mode, the expected time of each upcoming exchange is displayed in the "Real-Time S.P.O.T." view by the parameter [Get Next Handover Time](#).

SCPI command:

`<subsystem>:SATellite<st>:DURation` on page 147

Initial Code Phase

(enabled only in "Static" mode and for arbitrary navigation data source)

Sets the initial code phase.

In R&S WinIQSIM2, the actual simulated resolution for initial code phase depends on the sample rate. The selected [Initial Carrier Phase](#) is internally rounded to a sample. To increase the sample rate, use the [Oversampling](#) function.

SCPI command:

`<subsystem>:SATellite<st>:CPHase` on page 148

Pseudorange

Displays the propagation delay from satellite to receiver in meters and is calculated as follow:

$$\text{Pseudorange} = \text{Time Shift} * c / \text{Standard Chip Rate}$$
, where c is the speed of light.

In "Auto" power mode, this parameter affects the calculation of the displayed power level of the corresponding satellite.

The parameter is enabled for configuration in "Simulation Mode > Static".

In R&S WinIQSIM2, this parameter is forced to 0.

SCPI command:

`<subsystem>:SATellite<st>:PRANge` on page 149

Pseudorange Bias

(R&S SMBV instruments only)

Sets a bias to the [Pseudorange](#). The parameter is updated on -the-fly and can be used to bias the pseudorange of a satellite.

The parameter is enabled for configuration in "Auto/User Localization" modes.

SCPI command:

`<subsystem>:SATellite<st>:PRBias` on page 149

Time Shift/ chips

The parameter is enabled for configuration in "Static" mode. In R&S WinIQSIM2, it is forced to 0.

Displays the propagation delay from satellite to receiver. The time shift is displayed in chips.

In "Localization" mode, this parameter is not configurable and is set automatically depending on the simulated [Geographic Location](#) and on the satellite's orbit.

SCPI command:

`<subsystem>:SATellite<st>:TShift` on page 151

Doppler Shift

The parameter is enabled for configuration in "Static" mode.

Enters the Doppler shift of the simulated signal of the satellite. The simulation of Doppler-shifted signals can be used to check the receiver characteristics under more realistic conditions than with zero Doppler.

In "Localization" mode, this parameter is not configurable and is set automatically depending on the simulated "Geographic Location" and on the satellite's orbit.

The relevant change to the chip rate of the code is carried out automatically. The currently valid values for Doppler-shifted carrier frequency and chip rate are displayed under:

- [Resulting Start Frequency](#)
- [Resulting Start Chip Rate](#)
- [Resulting P-Code Chip Rate](#)

SCPI command:

`<subsystem>:SATellite<st>:DSHift` on page 147

Initial Carrier Phase

The parameter is enabled for configuration in "Simulation Mode > Static".

Sets the initial carrier phase. The parameter is updated automatically in "Auto/User Localization" modes.

In R&S WinIQSIM2, it is forced to 0.

SCPI command:

`<subsystem>:SATellite<st>:ICPHase` on page 148

Resulting Start Frequency

Indicates the currently valid values for Doppler-shifted carrier frequency.

The resulting frequency is calculated according to the following:

- GPS, Galileo
 - $f_{\text{resulting}} = f_{\text{band}} + f_{\text{Doppler}}$,
 - where f_{band} is set with parameter [RF Band](#).
- Glonass
 - $f_{\text{band_L1}} = 1602 \text{ MHz}$, $f_{\text{band_L2}} = 1247 \text{ MHz}$

k = frequency number

$$f_{\text{Glo_L1_resulting, MHz}} = 1602 + (k * 0.5625) + f_{\text{Doppler}}$$

$$f_{\text{Glo_L2_resulting, MHz}} = 1247 + (k * 0.4375) + f_{\text{Doppler}}$$

SCPI command:

[<subsystem>:SATellite<st>:FREQuency](#) on page 147

Resulting Start Chip Rate

Indicates the currently valid values for the chip rate. The relevant change to the chip rate is carried out automatically if the Doppler shift is changed.

The resulting chip rate is calculated according to the following:

- GPS, Galileo

$$f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / f_{\text{band}}\},$$
 where f_{band} is set with parameter [RF Band](#) and f_{code} is fixed to 1.023 MHz.
- Glonass on L1/E1 band

$$f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / [f_{\text{band}} + k * 562500 \text{ (Hz)}]\}$$
- Glonass on L2 band

$$f_{\text{resulting}} = f_{\text{code}} * \{1 + f_{\text{Doppler}} / [f_{\text{band}} + k * 437500 \text{ (Hz)}]\},$$

SCPI command:

[<subsystem>:SATellite<st>:CACRate](#) on page 146

Resulting P-Code Chip Rate

(R&S SMBV only)

Indicates the currently valid values for the chip rate of the P-code. The relevant change to the chip rate of the P-code is carried out automatically if the Doppler shift is changed.

The resulting P-chip rate is calculated according to the following:

$$f_{\text{P-resulting}} = f_{\text{P}} * \{1 + f_{\text{Doppler}} / f_{\text{band}}\}$$

where f_{band} is as set with parameter [RF Band](#) and f_{P} is fixed to 10.230 MHz.

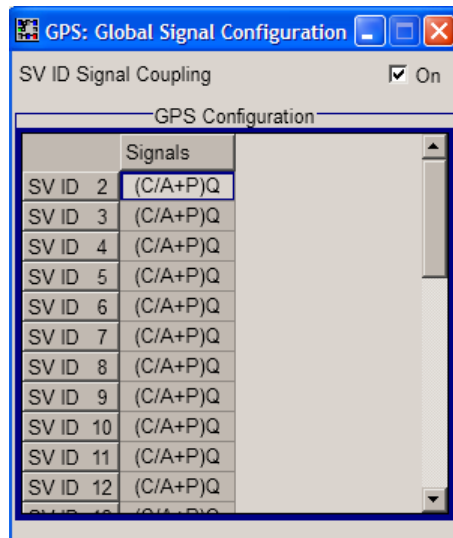
SCPI command:

[<subsystem>:SATellite<st>:PCRate](#) on page 148

3.5 Global Signal Configurations

The dialog displays all available SV ID of each of the enabled GNSS standards according to the selected almanac. For each available SV ID a signal can be assigned. Refer to [table 3-4](#) for an overview of the supported signals pre GNSS standard.

This configuration is required while working in "Auto Localization" mode and enables you to determine the type of signal a SV ID will use in the moment the corresponding satellite becomes visible.



SV ID Signal Coupling

For quick configuration, enables the configuration of all SV IDs simultaneously, i.e. the value set for the first available SV ID is used for all other. Current settings are overwritten.

SCPI command:

`<subsystem>:SVID:SIGNAL:COUPling` on page 151

GPS/Galileo/GLONASS Signals

In "Auto Localization" mode, determine the type of signal a SV ID will use in the moment the corresponding satellite becomes visible.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:SIGNal` on page 151

3.6 Atmospheric Configuration

The atmospheric configuration comprises the parameters for adjusting the ionospheric and tropospheric models of the navigation standards. The GPS and Galileo have specific ionospheric models; the one for GLONASS is not yet specified by the time this firmware had been developed. The ionospheric navigation parameters only define what the satellites are transmitting as ionospheric correction parameters whereas the model configuration describes the actual ionospheric and tropospheric models used in the satellite-receiver channel simulation.

The parameters in this dialog are enabled for configuration only for instruments equipped with the option GNSS Enhanced (R&S SMBV-K92).

GPS Atmospheric Configuration

<<< Hide Details

Tropospheric Configuration

Tropospheric Model: None

Ionospheric Configuration

Ionospheric Model: Klobuchar

alpha_0: 0 x 2⁻³⁰ = 0.000000e+00

alpha_1: 0 x 2⁻²⁷ = 0.000000e+00

alpha_2: 0 x 2⁻²⁴ = 0.000000e+00

alpha_3: 0 x 2⁻²⁴ = 0.000000e+00

beta_0: 0 x 2¹¹ = 0.000000e+00

beta_1: 0 x 2¹⁴ = 0.000000e+00

beta_2: 0 x 2¹⁶ = 0.000000e+00

beta_3: 0 x 2¹⁶ = 0.000000e+00

GALILEO Atmospheric Configuration

<<< Hide Details

Tropospheric Configuration

Tropospheric Model: None

Ionospheric Configuration

Ionospheric Model: WAAS

a_i0: 0 x 2⁻² = 0.000000e+00

a_i1: 0 x 2⁻⁸ = 0.000000e+00

a_i2: 0 x 2⁻¹⁵ = 0.000000e+00

SF_1: 0

SF_2: 0

SF_3: 0

SF_4: 0

SF_5: 0

Tropospheric Model

Determines whether a STANAG tropospheric model is applied or not.

SCPI command:

[<subsystem>:ATMospheric:GPS:TROPospheric:MODEl](#) on page 178

[<subsystem>:ATMospheric:GALileo:TROPospheric:MODEl](#) on page 178

[<subsystem>:ATMospheric:GLONass:TROPospheric:MODEl](#) on page 178

Ionospheric Model

Determines the applied ionospheric model.

The GPS ionospheric configuration uses the Klobuchar ionospheric model.

SCPI command:

`<subsystem>:ATMospheric:GPS:IONospheric:MODEl` on page 178

`<subsystem>:ATMospheric:GALileo:IONospheric:MODEl` on page 179

`<subsystem>:ATMospheric:GLONass:IONospheric:MODEl` on page 179

GPS Ionospheric Parameters

Changing the ionospheric model has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".

Parameter	Description	SCPI Command
"alpha_0 .. alpha_3"	Displays the parameter alpha_0 .. alpha_3 of the satellite's navigation message.	<code><subsystem>:ATMospheric:GPS:IONospheric:ALPHa<ch0></code> on page 178
"beta_0 .. beta_3"	Displays the parameter beta_0 .. beta_3 of the satellite's navigation message.	<code><subsystem>:ATMospheric:GPS:IONospheric:BETA<ch0></code> on page 178

GALILEO Ionospheric Parameters

The GALILEO ionospheric model includes the broadcast coefficients a_{i0} , a_{i1} and a_{i2} used to compute the Effective Ionization Level A_z and the "Ionospheric Disturbance Flag", given for five different regions.

Changing the ionospheric model has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".

Parameter	Description	SCPI Command
"a_i0 .. a_i2"	Displays the parameters effective Ionization level 1 st .. 3 rd order of the satellite's navigation message.	<code><subsystem>:ATMospheric:GALileo:IONospheric:AI<ch0></code> on page 179
"SF_1 .. SF_5"	Displays the parameters ionospheric disturbance flag for region 1 to 5 of the satellite's navigation message.	<code><subsystem>:ATMospheric:GALileo:IONospheric:SF<ch></code> on page 179

3.7 Satellites Power Tuning

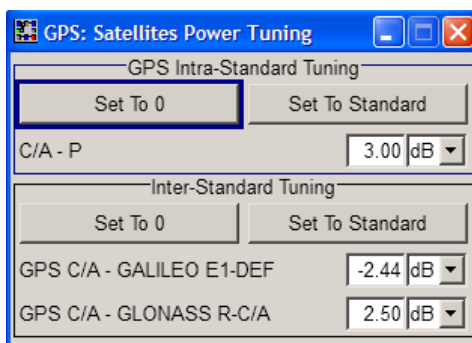


The parameters of "Power Tuning" are only configurable for R&S SMBV instruments.

The Satellite Power Tuning dialog comprises the setting for inter-standard power relations and the power relation between the signals of a specific GNSS standard.

The inter-standard parameters are required for the configuration of the nominal power difference between the different navigation standards. These parameters are considered only in "Auto Power Mode".

See [chapter 3.4.1, "Power Configuration"](#), on page 55 for information about the power calculation.



Intra-Standard Tuning

Intra-Standard power settings are provided for GPS mixed signals. The C/A signal is always used as "Power Reference".

Set to 0 ← Intra-Standard Tuning

Sets the power relations between the signal components to 0 dB.

SCPI command:

[<subsystem>:POWer:INTRa:GPS:PZERo](#) on page 155

Set to Standard ← Intra-Standard Tuning

Sets the power relation between the signals belonging to the same navigation standard according to the relation determined in the specifications.

Table 3-5: Intra-Standard Tuning

Parameter	Value
C/A - P	3 dB

SCPI command:

[<subsystem>:POWer:INTRa:GPS:PSTandard](#) on page 156

C/A-P ← Intra-Standard Tuning

Sets the power relation between the signals belonging to the same navigation standard. Use the [Set to Standard](#) function to preset the values.

SCPI command:

[<subsystem>:POWer:INTRa:GPS:CAP](#) on page 156

Inter-Standard Tuning

The inter-standard calculation is performed based on the GPS standard.

Set to 0 ← Inter-Standard Tuning

Sets the Inter-Standard Power relations to 0 dB.

SCPI command:

[<subsystem>:POWer:INTer:PZERo](#) on page 155

Set to Standard ← Inter-Standard Tuning

Sets the power relation between the signals belonging to the different navigation standard according to the relation determined in the specifications.

Table 3-6: Inter-Standard Tuning

Parameter	Value
GPS C/A - GALILEO E1-DEF	-2.44 dB
GPS C/A - GLONASS R-C/A	3.03dB

SCPI command:

`<subsystem>:POWer:INTer:PSStandard` on page 155

GPS C/A-GALILEO E1-DEF, GPS C/A-GLONASS R-C/A ← Inter-Standard Tuning

Sets the power relation between the signals belonging to the different navigation standards. Use the [Set to Standard](#) function to preset the values.

The power level of the GPS signal C/A is used as reference.

SCPI command:

`<subsystem>:POWer:INTer:CAE1Def` on page 155

`<subsystem>:POWer:INTer:CARCA` on page 155

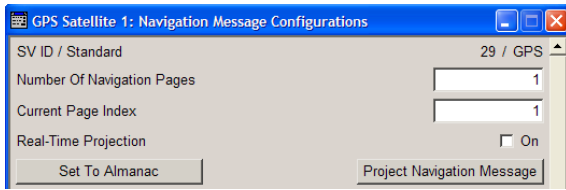
3.8 Navigation Message Configuration



The parameters of the Navigation Message are only configurable for R&S SMBV instruments equipped with one of the assisted options, e.g. Assisted GPS (R&S SMBV-K65). The parameters of the "Navigation Message Configuration" dialog are enabled for configuration only in "User Localization" and "Static Mode" mode on the R&S SMBV; in "Auto Localization" and R&S WinIQSIM2 "Static" modes, the parameters of the navigation message of each satellite are read only.

Although the navigation messages are fully configurable, it is recommended to use the almanac's parameter as basis for further configurations (see ["Set To Almanac"](#) on page 78).

For better readability of the parameters in the "Navigation Message Configuration" dialog, the corresponding values are input as integer in the same way as they are included in the satellite's navigation message, but the scaled values and the scaling factors are also displayed.



(R&S SMBV instruments only)

Ephemeris Parameters	
<input type="button" value="Hide Details"/>	
Code On L2	Reserved
L2 P Data Flag	<input type="checkbox"/> On
Fit Interval Flag	<input type="checkbox"/> On
SV Accuracy / URA Index	0
SV Health	0
IODC	100
IODE	100
TOE	3 839 x 2 ⁴ = 6.142400e+04
M_0	516 118 986 x 2 ⁻³¹ = 2.403366e-01
Delta_N	0 x 2 ⁻⁴³ = 0.000000e+00
e	52 944 896 x 2 ⁻³³ = 6.163597e-03
SQRT(A)	2 702 023 424 x 2 ⁻¹⁹ = 5.153701e+03
OMEGA_0	52 954 112 x 2 ⁻³¹ = 2.465868e-02
i_0	656 176 742 x 2 ⁻³¹ = 3.055561e-01
omega	-627 985 152 x 2 ⁻³¹ = -2.924284e-01
OMEGA_DOT	-23 136 x 2 ⁻⁴³ = -2.630259e-09
IDOT	0 x 2 ⁻⁴³ = 0.000000e+00
C_uc	0 x 2 ⁻²⁹ = 0.000000e+00
C_us	0 x 2 ⁻²⁹ = 0.000000e+00
C_rc	0 x 2 ⁻⁵ = 0.000000e+00
C_rs	0 x 2 ⁻⁵ = 0.000000e+00
C_ic	0 x 2 ⁻²⁹ = 0.000000e+00
C_js	0 x 2 ⁻²⁹ = 0.000000e+00
SF1 Reserved 1	0
SF1 Reserved 2	0
SF1 Reserved 3	0
SF1 Reserved 4	0
AODO	31
(A-S) Flags and SV Config	1

GPS Satellite

Ephemeris Parameters	
<input type="button" value="Hide Details"/>	
SISA	0
IODnav	0
IODa	0
TOE	1 020 x 60 = 6.120000e+04
M_0	0 x 2 ⁻³¹ = 0.000000e+00
Delta_N	0 x 2 ⁻⁴³ = 0.000000e+00
e	0 x 2 ⁻³³ = 0.000000e+00
SQRT(A)	2 852 483 236 x 2 ⁻¹⁹ = 5.440680e+03
OMEGA_0	-763 549 932 x 2 ⁻³¹ = -3.555556e-01
i_0	668 106 027 x 2 ⁻³¹ = 3.111111e-01
omega	0 x 2 ⁻³¹ = 0.000000e+00
OMEGA_DOT	-46 442 x 2 ⁻⁴³ = -5.279844e-09
IDOT	0 x 2 ⁻⁴³ = 0.000000e+00
C_uc	0 x 2 ⁻²⁹ = 0.000000e+00
C_us	0 x 2 ⁻²⁹ = 0.000000e+00
C_rc	0 x 2 ⁻⁵ = 0.000000e+00
C_rs	0 x 2 ⁻⁵ = 0.000000e+00
C_ic	0 x 2 ⁻²⁹ = 0.000000e+00
C_js	0 x 2 ⁻²⁹ = 0.000000e+00

Galileo Satellite

Ephemeris Parameters

<<< Hide Details

Satellite Ephemeris Type (M)

SV Accuracy / URA Index (F_T)

SV Health (B_n,1_n)

Age of Ephemeris Page (P1)

Tb-Index

Tb-Interval [10:30:00-11:00:00]

TOE (tb) 10:45:00

P

X_n x 2⁻¹¹ = 6.138350e+02

Y_n x 2⁻¹¹ = -1.297494e+04

Z_n x 2⁻¹¹ = 2.195661e+04

XDOT_n x 2⁻²⁰ = 3.232608e+00

YDOT_n x 2⁻²⁰ = 1.995776e+00

ZDOT_n x 2⁻²⁰ = 1.091404e+00

XDDOT_n x 2⁻³⁰ = 0.000000e+00

YDDOT_n x 2⁻³⁰ = 0.000000e+00

ZDDOT_n x 2⁻³⁰ = 0.000000e+00

GLONASS Satellite

Clock Correction Parameters

<<< Hide Details

T_GD x 2⁻³¹ = 0.000000e+00

t_OC x 2⁻⁴ = 5.112000e+05

a_f2 x 2⁻⁵⁵ = 0.000000e+00

a_f1 x 2⁻⁴³ = 0.000000e+00

a_f0 x 2⁻³¹ = 0.000000e+00

Clock Correction Parameters

<<< Hide Details

TAU_n (-a_f0) x 2⁻³⁰ = 1.792908e-04

GAMMA_n (a_f1) x 2⁻⁴⁰ = 0.000000e+00

Delta_TAU_n x 2⁻³⁰ = 0.000000e+00

E_n

GPS Satellite

INAV Parameters

<<< Hide Details

B_GD (E1-E5B) x 2⁻³² = 0.000000e+00

T_OC (E1-E5B) x 60 = 6.120000e+04

a_f2 (E1-E5B) x 2⁻⁵⁹ = 0.000000e+00

a_f1 (E1-E5B) x 2⁻⁴⁶ = 3.637979e-12

a_f0 (E1-E5B) x 2⁻³⁴ = -1.564026e-04

E1B_DVS

E5B_DVS

E1B_HS

E5B_HS

GLONASS Satellite

FNAV Parameters

<<< Hide Details

B_GD (E1-E5A) x 2⁻³² = 0.000000e+00

T_OC (E1-E5A) x 60 = 0.000000e+00

a_f2 (E1-E5A) x 2⁻⁵⁹ = 0.000000e+00

a_f1 (E1-E5A) x 2⁻⁴⁶ = 0.000000e+00

a_f0 (E1-E5A) x 2⁻³⁴ = 0.000000e+00

E5A_DVS

E5A_HS

K

Galileo Satellite

Galileo Satellite

SV-ID / Standard

Displays the SV ID and the navigation standard the navigation message is related to.

SCPI command:

n.a.

Number of Navigation Pages

(Requires installed assistance option, e.g. Assistance GPS R&S SMBV-K65)

Several navigation pages are available per satellite.

If RINEX file is used, the value of this parameter is retrieved from the file. A RINEX file may contains ephemeris information for up to 24h. Since the ephemeris are update every two hours, the RINEX file contains a maximum number of 12 navigation pages.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:PAGE:COUNT` on page 159

Current Page Index

(Requires installed assistance option, e.g. Assistance GPS R&S SMBV-K65)

Select a specific page from all available navigation pages ([Number of Navigation Pages](#)) and enables the set of ephemeris parameters of this page for configuration.

SCPI command:

n.a.

Real-Time Projection

(enabled in "User Localization" mode and disabled "Satellite Configuration > [Global Ephemeris Real-Time Projection](#)")

Enables the instrument to internally perform a projection of the navigation message whenever this message is approaching its validity limit.

When using RINEX file containing information for up to 24 hours, the navigation page to be used is selected in the way, that the simulation start time is within the time span from TOE to TOE+2h, i.e. $TOE \leq \text{Current Simulation Time} \leq TOE+2h$.

It may however happen, that the required consecutive navigation page is missing in the RINEX file. The enabled "Real-Time Projection" assures the automatic projection of the navigation message, i.e. the ephemeris set will contain valid data again.

Note: "Real-Time Projection" have to be disabled, if assistance data will be generated.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:RTPProjection` on page 159

Set To Almanac

(enabled only in "User Localization" mode)

The navigation message's parameters will be calculated according to the selected almanac.

Using this option as basis for further reconfiguration is recommended.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:NMESsage:PRESet` on page 159

Project Navigation Message

(enabled only in "User Localization" mode)

Triggers the projection of the parameters of the navigation message. The values of the TOE and TOC are calculated according to the selected current simulation time (for "System Time UTC", as selected with the parameters [Date \[dd.mm.yyyy\]](#) and [Time \[hh:mm:ss:xxx\]](#)). The updated values of the ephemeris and clock correction are displayed.

Note: Use this function prior to the generation of assistance data, if RINEX files are not used.

The projection affects the parameters of the signal at the exact moment the satellite is activated. Thus, if projection is required, trigger the projection at the beginning of the satellite signal generation.

SCPI command:

[<subsystem>:SVID<ch>:<GNSS>:NMESsage:PROJect](#) on page 159

GPS and Galileo Common Ephemeris Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

Table 3-7: Common Ephemeris Parameters

Parameter	Description	SCPI command
M_0	Mean Anomaly at Reference Time ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:MZERo on page 165
Delta_N	Mean Motion Difference From Computed Value ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:NDELta on page 166
e	Eccentricity ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:ECCentricity on page 163
SQRT(A)	Square Root of the Semi-Major Axis ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:SQRA on page 167
OMEGA_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:OZERo on page 167
i_0	Inclination Angle at Reference Time ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:IZERo on page 165
Omega	Argument of Perigee ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:OMEGa on page 166
OMEGA_DOT	Rate of Right Ascension ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:ODOT on page 166
IDOT	Rate of Inclination Angle ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:IDOT on page 164
¹⁾	As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)". The value of these parameters will be updated automatically.	

Parameter	Description	SCPI command
C_uc	Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CUC on page 163
C_us	Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CUS on page 163
C_rc	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CRC on page 162
C_rs	Amplitude of the Sine Harmonic Correction Term to the Orbit Radius ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CRS on page 162
C_ic	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CIC on page 161
C_is	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: CIS on page 161
TOE	Time Of Ephemeris ⁽¹⁾	<subsystem>:SVID<ch>:<GNSS>: NMESsage[:PAGE<us>]:EPHemeris: TOE on page 168
¹⁾	As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10)". The value of these parameters will be updated automatically.	

GPS Ephemeris Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

Table 3-8: GPS Ephemeris Parameters

Parameter	Description	SCPI command
Code on L2	Type of code for L2; This value does not have any impact on the actual used ranging code of the generated satellite. The used "Ranging Code" is set in the "Satellite Configuration" menu. <ul style="list-style-type: none"> "Reserved" Reserved for future use. "P Code ON" Carrier L2 (f_{L2}= 1.2276 GHz) is modulated by P-code (BPSK). "C/A Code ON" Carrier L2 (f_{L2}= 1.2276 GHz) is modulated by C/A-code (BPSK). 	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: CLTMode on page 162
L2 P Data Flag	Use of carrier L2 P data flag This value does not have an impact on whether really data is transmitted on the satellite's carrier L2 or not.	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: LTPData on page 165
Fit Interval Flag	Indicates the curve-fit interval used by the CS (Control Segment) in determining the ephemeris parameters	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: FIFLag on page 163
SV accuracy / URA Index		<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: URA on page 168
SV Health	This value does not have an impact on the actual health status of the generated satellite.	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: HEALth on page 164
IODC	Issue of Data, Clock	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: IODC on page 164
IODE	Issue of Data, Ephemeris	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: IODE on page 164
SF1 Reserved 1/2/3/4		<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: SF1Reserved<s2us> on page 167
AODO	Age of Data Offset	<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: AODO on page 161
(A-S) Flags and SV Configurations		<subsystem>:SVID<ch>:GPS: NMESsage[:PAGE<us>]:EPHemeris: SVConfig on page 168
¹⁾	As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)". The value of these parameters will be updated automatically.	

Galileo Ephemeris Parameters

Comprises the Galileo specific ephemeris parameters.

Table 3-9: Galileo Specific Ephemeris Parameters

Parameter	Description	SCPI command
SISA	Signal In Space Accuracy	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:EPHemeris: SISA on page 167
IODnav	Issue Of Data (Ephemeris and Clock correction)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:EPHemeris: IODNav on page 165
IODa	Issue Of Data (Almanacs)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:EPHemeris: IODA on page 164

GLONASS Ephemeris Parameters

Comprises the GLONASS specific ephemeris parameters.

Table 3-10: GLONASS Specific Ephemeris Parameters

Parameter	Description	SCPI command
Satellite Ephemeris Type (M)	Satellite ephemeris types GLONASS, GLONASS-M	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: SEType on page 174
SV accuracy / URA Index (F_T)	Provides the predicted satellite user range accuracy (URA).	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: URA on page 176
SV Health (B_n,1_n)	A health value. The user navigation equipment analyzes only the MSB of this word. <ul style="list-style-type: none"> B_n[3] = 1_n = 1 Satellite not healthy B_n[3] = 1_n = 0 Satellite is healthy 	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: HEALth on page 173
Age of Ephemeris Page (P1)	Time interval between 2 adjacent values of TOE. It defines hence the age of the current Glonass Ephemeris page. This parameter maps to the P1 parameter in the navigation message as follows: <ul style="list-style-type: none"> 01 Age of Ephemeris = 30 min 10 Age of Ephemeris = 45 min 11 Age of Ephemeris = 60 min Note: Tb-Interval and TOE displays depend on this value.	<subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: AOEP on page 173

Parameter	Description	SCPI command
Tb-Index	<p>Index of the Tb-time interval. Time of Ephemeris (TOE) corresponds to this value multiplied by 15 minutes. This value is actually a scaled TOE value with a unit of 15 minutes.</p> <p>Note: Tb-Interval and TOE displays depend on this value. Condition to be always met:</p> <ul style="list-style-type: none"> • (Tb-Index – 1) should be an integer multiple of (Age of Ephemeris [min] / 15) • Case 1: Age of Ephemeris = 30 min Tb-Index = 1, 3, 5... 95 • Case 2: Age of Ephemeris=45 min Tb-Index = 1, 4, 7... 94 • Case 3: Age of Ephemeris = 60 min Tb-Index = 1, 5, 9... 93 	<p><subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: TINDEX on page 174</p>
Tb-Alignment (P2)	<p>Configures TOE to be aligned to an even or odd scale of 15 min for "Age of Ephemeris" = 30 or 60 min.</p> <p>Forced to "1", hence odd in case of Age of Ephemeris = 45 min</p> <p>Note: All Ephemeris pages of an SVID have the same Tb alignment (P2).</p> <p>The Tb-Interval and TOE parameters depend on this value.</p>	<p><subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: TALIGNment on page 174</p>
Tb-Interval	<p>Displays the Tb-Interval in the current day where the Ephemeris set page is valid.</p> $\text{Tb-Interval} = [((\text{Tb} - 1 + \text{P2}) * 15 * 60) - \text{AgeOfEphemeris} / 2]$ <p>Examples:</p> <ul style="list-style-type: none"> • tb = 45, P2 = 1 and Age of Eph = 30 Tb-Interval = [11:00:00 11:30:00] • tb = 45, P2 = 1 and Age of Eph = 45 Tb-Interval = [10:52:30 11:37:30] • tb = 45, P2 = 0 and Age of Eph = 60 Tb-Interval=[10:30:00 11:30:00] 	<p><subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: TINTERval on page 175</p>
TOE (tb)	<p>Displays the time of Ephemeris in the current day. Also referred to in the standard as the middle of the Tb-Interval or tb. This parameter is equivalent to DayTime[(Tb - 1 + P2) * 15 * 60 seconds] and independent of "Age of Ephemeris".</p> <p>Examples:</p> <ul style="list-style-type: none"> • tb = 45, P2 = 1 • tb = 45, P2 = 1 • tb = 45, P2 = 0 TOE = 11:00:00 	<p><subsystem>:SVID<ch>:GLONass: NMESsage[:PAGE<us>]:EPHemeris: TOE on page 176</p>

Parameter	Description	SCPI command
p	Reliability measure of system time conversion parameters. <ul style="list-style-type: none"> • 00 TAU_C and TAU_GPS relayed from control segment. • 01 TAU_C from control segment; TAU_GPS calculated on board GLONASS-M satellite. • 10 TAU_C on board Glonass-M satellite and TAU_GPS relayed from CS. • 11 TAU_C and TAU_GPS calculated on board Glonass-M satellites. 	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:P</code> on page 173
X_n	The OX position coordinate of the current satellite at TOE(tb), i.e. the middle of the Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: XN</code> on page 176
Y_n	The OY position coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: YN</code> on page 176
Z-n	The OZ position coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: ZN</code> on page 176
XDOT_n	The OX velocity coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: XDN</code> on page 177
YDOT_n	The OY velocity coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: YDN</code> on page 177
ZDOT_n	The OZ velocity coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: ZDN</code> on page 177
XDDOT_n	The OX acceleration coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: XDDN</code> on page 177
YDDOT_n	The OY acceleration coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: YDDN</code> on page 177
ZDDOT_n	The OZ acceleration coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval ⁽¹⁾ .	<code><subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris: ZDDN</code> on page 177

¹: The coordinates correspond to the PZ-90 coordinate system.

GPS Clock Correction Parameters

The ephemeris parameters correspond to the SV ID and navigation standard displayed with the parameter [SV-ID / Standard](#) and to the navigation page determined by the [Current Page Index](#).

Table 3-11: GPS Clock Correction Parameters

Parameter	Description	SCPI command
T_GD	L1-L2 Correction Term ⁽¹⁾	<code><subsystem>:SVID<ch>:GPS: NMEsSage[:PAGE<us>]: CCORrection:TGD on page 160</code>
t_OC a_f2 a_f1 a_f0	Clock Correction Parameter ⁽¹⁾	<code><subsystem>:SVID<ch>:GPS: NMEsSage[:PAGE<us>]: CCORrection:TOC on page 161 <subsystem>:SVID<ch>:GPS: NMEsSage[:PAGE<us>]: CCORrection:AF<s2us0> on page 160</code>

¹: As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)".

The value of these parameters will be updated automatically.

GLONASS Clock Correction Parameters

Comprises the GLONASS specific parameters for clock correction.

Table 3-12: GLONASS Clock Correction Parameters

Parameter	Description	SCPI command
TAU_n (-a_f0)	SV Clock bias correction coefficient	<code><subsystem>:SVID<ch>:GLONass: NMEsSage[:PAGE<us>]: CCORrection:TAUN on page 172</code>
GAMMA_n (a_f1)	SV Clock drift correction coefficient	<code><subsystem>:SVID<ch>:GLONass: NMEsSage[:PAGE<us>]: CCORrection:GAMN on page 172</code>
Delta_TAU_n	Time difference between navigation RF signal transmitted in L2 and navigation RF signal transmitted in L1 band	<code><subsystem>:SVID<ch>:GLONass: NMEsSage[:PAGE<us>]: CCORrection:DTAU on page 172</code>
E_n	Age of operation information	<code><subsystem>:SVID<ch>:GLONass: NMEsSage[:PAGE<us>]: CCORrection:EN on page 172</code>

Galileo INAV Parameters

Comprises the parameters of the Integrity navigation message I/NAV, provided by E5b and E1-B signals and supporting Safety of Life Service. The I/NAV message carries extended system integrity information.

Table 3-13: INAV Parameters

Parameter	Description	SCPI command
B_GD (E1-E5B)	E1-E5b Broadcast Group Delay BGD(E1,E5b)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:BGD on page 170
T_OC (E1-E5B)	Clock correction data reference Time of Week $t_{oc}(E1,E5b)$	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:TOC on page 171
a_f2 (E1-E5B)	SV clock drift rate correction coefficient $a_{f2}(E1,E5b)$	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV: AF<s2us0> on page 170
a_f1 (E1-E5B)	SV clock drift correction coefficient $a_{f1}(E1,E5b)$	
a_f0 (E1-E5B)	SV clock bias correction coefficient $a_{f0}(E1,E5b)$	
E1B_DVS	Data Validity Satellite Status, transmitted on E1-B (E1-B _{DVS})	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E1BDVS on page 171
E5B_DVS	Data Validity Satellite Status, transmitted on E5b (E5b _{DVS})	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E5BDVS on page 171
E1B_HS	Signal Health Status for E1 (E1-B _{HS})	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E1BHS on page 171
E5B_HS	Signal Health Status for E5b (E5b _{HS})	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:INAV:E5BHS on page 171

Galileo FNAV Parameters

Comprises the parameters of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Table 3-14: FNAV Parameters

Parameter	Description	SCPI command
B_GD (E1-E5A)	E1-E5a Broadcast Group Delay BGD(E1,E5a)	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV:BGD on page 169
T_OC (E1-E5A)	Clock correction data reference Time of Week $t_{oc}(E1,E5a)$	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV:TOC on page 170
a_f2 (E1-E5A)	SV clock drift rate correction coefficient $a_{f2}(E1,E5a)$	<subsystem>:SVID<ch>:GALileo: NMESsage[:PAGE<us>]:FNAV: AF<s2us0> on page 168
a_f1 (E1-E5A)	SV clock drift correction coefficient $a_{f1}(E1,E5a)$	

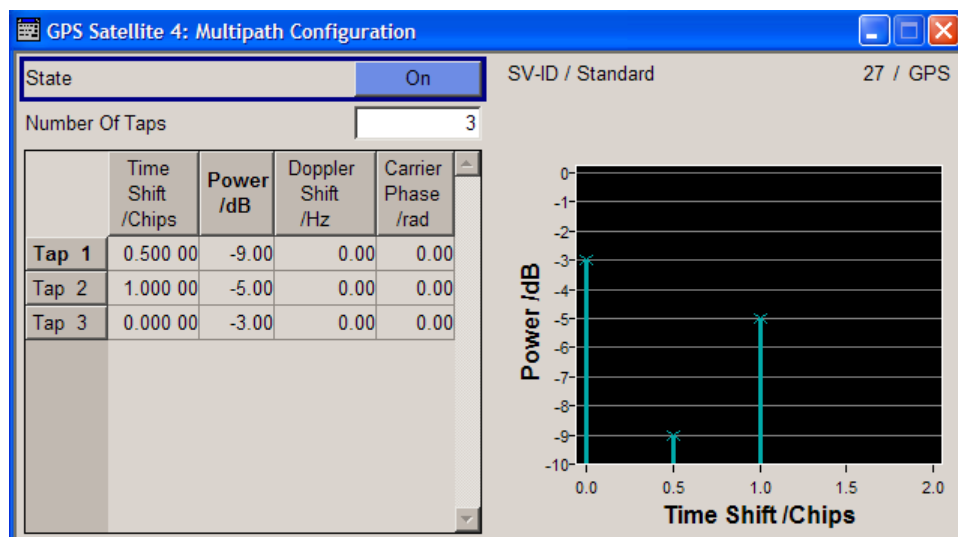
Parameter	Description	SCPI command
a_f0 (E1-E5A)	SV clock bias correction coefficient $a_{f_0}(E1,E5a)$	
E5A_DVS	Data Validity Satellite Status, transmitted on E5a ($E5a_{DVS}$)	<code><subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5ADVS</code> on page 169
E5A_HS	Signal Health Status for E5a ($E5a_{HS}$)	<code><subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5AHS</code> on page 169
K	F-NAV Almanac Scheduling start index	<code><subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:K</code> on page 169

3.9 Multipath Configuration

The "Multipath Configuration" dialog enables you to configure the signal parameters of the selected satellite, so that a signal undergoing multipath propagation is simulated. The provided settings enable configuration of the number of fading taps and individual configuration of the time and Doppler shift, power and carrier phase per tap. The resulting propagation is displayed in the graph on the right side of the dialog.



The parameters of the "Multipath Configuration" are only configurable for R&S SMBV instruments in equipped the assisted option (R&S SMBV-K92). Additionally, the parameters of the "Navigation Message Configuration" dialog are enabled for configuration only in "User Localization" mode.



State

Enables/disables the generation of multipath signal for the satellite with the displayed SV ID belonging to the displayed GNSS standard. Settings made in the dialog are considered only if the multipath configuration is enabled.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:STATe` on page 140

SV ID / Standard

Displays the SV ID and the GNSS standard the satellite is belonging to.

SCPI command:

n.a.

Number of Taps

Sets the paths number. The value determines the number of rows available for configuration.

The maximum value for this parameter is calculated dynamically and depends on the active GNSS standard, the hybrid GNSS configuration and the enabled multipath configurations of the other satellites (see [table 3-15](#)).

Table 3-15: Multipath budgeting

Satellite constellation	Total number of multipath budget
Consisting of GPS satellites only	16
Consisting of Galileo satellites only	12
Hybrid configuration	between 12 and 16

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT` on page 140

Multipath Taps Table

Comprises the settings of the taps. The number of taps, i.e. the table rows is determined by the parameter [Number of Taps](#).

Time Shift / Chips ← Multipath Taps Table

Sets an additional delay of the selected satellite, used to simulate multipath conditions.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TSHift` on page 142

Power ← Multipath Taps Table

Sets the additional power of the satellite in dB, used to simulate multipath conditions.

See [chapter 3.4.1, "Power Configuration"](#), on page 55 for information about the power calculation.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWER` on page 141

Doppler Shift /Hz ← Multipath Taps Table

Enters the additional Doppler shift of the simulated signal of the satellite, used to simulate multipath conditions.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift` on page 141

Carrier Phase /rad ← Multipath Taps Table

Sets the carrier phase, used in case of multipath simulation.

SCPI command:

`<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase` on page 141

3.10 Assistance Data Generation



The "Assistance Data Generation" dialog is only available for instrument equipped with one of options for assisted satellite navigation, e.g. A-GPS (R&S SMBV-K65).

To access the "Assistance Data Generation" dialog, select "Main Dialog > Simulation Mode User Localization" and select "Assistance Data Generation".

The "Assistance Data Generation" dialog is used to generate assistance data files for Assisted-GPS testing. These files can be formatted into mobile communication's message formats and passed by the protocol tester to the DUT in order to speed up Time To First Fix (TTFF). See also [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27.

The upper part of the "Assistance Data Generation" dialog is where the "Assistance Mode" and the "Space Vehicle Selection" are set. The middle part of the dialog comprises the parameters of the "Reference Location" and "Time Configuration". The lower part of the dialog offers assistance in the generation of the "Almanac", "Ionospheric", "Navigation", "UTC" and "Acquisition" files.

The R&S SMBV provides a two-level synchronization concept. The "Synchronize All" function enables you to perform a fast reload of all parameters in the dialog. Selective settings alignment is enabled by means of the "Synchronize" functions in each of the individual parameter groups. Although the selection of the satellite, the configuration of the reference location and the time configuration parameters are fully user-definable, it is recommended to use the synchronisation function to retrieve the values for the relevant parameters from the GNSS main dialog as basis for further configuration.

Assistance Mode

Defines the type of assistance data to be loaded.

SCPI command:

`<subsystem>:ADGeneration:MODE` on page 183

Synchronize All/Synchronize

Parameter	Description	SCPI command
"Synchronize All"	Synchronizes the parameters of the satellites configuration and of the reference location configuration blocks as well as the time configuration parameters with the settings made in the "Satellite Configuration" dialog and in the "GNSS Main Dialog". Note: Synchronized are only the GPS satellites; all other satellites, like the Galileo satellites, are disregarded.	<code><subsystem>:ADGeneration:GPS:SYNChronize</code> on page 183
"Synchronize"	Synchronizes the settings of the corresponding parameter group.	<code><subsystem>:ADGeneration:GPS:SVID:SYNChronize</code> on page 183 <code><subsystem>:ADGeneration:GPS:LOCation:SYNChronize</code> on page 183 <code><subsystem>:ADGeneration:GPS:TOAData:SYNChronize</code> on page 183

Space Vehicle State

Enables/disables a space vehicle with the selected SV ID for generation of assistance data.

Use the "Synchronize" function to retrieve the SV ID belonging to the selected navigation standard ([Assistance Mode](#)), as configured in the "Satellite Configuration" dialog.

SCPI command:

`<subsystem>:ADGeneration:GPS:SVID<ch>:STATe` on page 183

Reference Location

The reference location section provides access to the parameters for setting the coordinates of the reference location.

Parameter	Description
"Position Format"	Sets the format in which the Latitude and Longitude are displayed. <ul style="list-style-type: none"> "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. <code>XX°XX'XX.XX" Direction</code>, where direction can be North/South and East/West. "Decimal Degree" The display format is decimal degree, i.e. <code>+/-XX.XXXXXX°</code>, where "+" indicates North and East and "-" indicates South and West.
"Altitude"	Sets the geographic altitude of the reference location in meters above sea level.
"Latitude"	Sets the latitude of the reference location.

Parameter	Description
"Longitude"	Sets the longitude of the reference location.
"Uncertainty Radius"	Sets the maximum radius of the area within which the two dimensional location of the UE is bounded. The uncertainty radius determines the required sensitivity of the DUT.

SCPI command:

[<subsystem>:ADGeneration:GPS:LOCation:URADius](#) on page 185

to enter the coordinates in Degree:Minute:Second format

[<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DMS](#) on page 184

to enter the coordinates in decimal degree format

[<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DECimal](#)
on page 184

Time Basis

Determines the time basis used to enter the time of assistance data parameters.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:TBASis](#) on page 186

Date [dd.mm.yyyy]

(enabled for "Time Basis" set to UTC)

Enters the date for the assistance data in DD.MM.YYYY format of the Gregorian calendar.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:DATE](#) on page 186

Time [hh:mm:ss]

(enabled for "Time Basis" set to UTC)

Enters the exact start time for the assistance data in UTC time format.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:TIME](#) on page 186

Week Number

(enabled for "Time Basis" set to GPS)

Enters week number (WN) the assistance data is generated for.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:WNUMber](#) on page 188

Time of Week

(enabled for "Time Basis" set to GPS)

Determines the Time of Week (TOW) the assistance data is generated for.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:TOWeek](#) on page 187

Duration

Sets the duration (in ms) of the assistance data.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:DURation](#) on page 187

Resolution

Sets the resolution (in ms) of the assistance data.

SCPI command:

[<subsystem>:ADGeneration:GPS:TOAData:RESolution](#) on page 187

Generate Almanac File ...

Opens the "Generate Almanac File" window for saving the generated almanac file. The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The almanac file is generated either in a GPS standard almanac file `.rs_al` format (see [table 3-16](#)) or as standard Yuma formatted file `.rs_yuma` and can be therefore used as the main almanac source for GPS.

Table 3-16: Contents of the generated almanac file

Parameter	Unit
SatID	-
e	dimensionless
toa	sec
delta_i	semi-circles
OMEGADOT	semi-circles/sec
SV Health	boolean
SQRT(A)	meters
OMEGA0	semi-circles
M0	semi-circles
w	semi-circles
af0	seconds
af1	sec/sec

The generated almanac file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0. The file lists all possible satellites, available from the source almanac file.

See [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27 for description of the workflow for generation of assistance data.

SCPI command:

[<subsystem>:ADGeneration:ALManac:CREate](#) on page 188

Generate Ionospheric File ...

Opens the "Select Ionospheric File" window for saving the generated ionospheric model.

The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button. The generated ionospheric file is file with extension `.rs_ion`.

The parameters listed in this file (see [table 3-17](#)) are according to the parameters used for describing the near satellite ionospheric model "Klobuchar". The generated ionospheric file contains one entry per standard.

Table 3-17: Contents of the generated ionospheric file

Parameter	Unit
alpha_0	seconds
alpha_1	sec/semi-circles
alpha_2	sec/(semi-circles) ²
alpha_3	sec/(semi-circles) ³
beta_0	seconds
beta_1	sec/semi-circles
beta_2	sec/(semi-circles) ²
beta_3	sec/(semi-circles) ³

See [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27 for description of the workflow for generation of assistance data.

SCPI command:

`<subsystem>:ADGeneration:IONospheric:CREate` on page 189

Generate Navigation File ...

Opens the "Select Navigation File" window for saving the generated navigation model (ephemeris). The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button. The generated navigation file is a file with extension `.rs_nav`.

Additionally, RINEX file can be also generated to export the ephemeris assistance data. The reference for the generating of the ephemeris page of each satellite is the "Time of Assistance Data". The generated RINEX file is a file with extension `.10n`. The generated RINEX file is conformed to the standard RINEX file format, as described in [chapter B.1, "RINEX Format Description"](#), on page 218.

The generated navigation file comprises the GPS standard ephemeris and clock correction parameters of the navigation model (see [table 3-18](#)).

Table 3-18: Contents of the generated navigation file

Parameter	Unit
SatID	-
Sat Status	-
C/A or P on L2	boolean
URA Index	boolean
SV Health	boolean

Parameter	Unit
IODC	-
L2 P Data Flag	boolean
SF 1 Reserved	-
T_{GD}	sec
t_{oc}	sec
af2	sec/sec ²
af1	sec/sec
af0	sec
C_{rs}	meters
delta_n	semi-circles/sec
M_0	semi-circles
C_{UC}	radians
e	-
C_{US}	radians
$(A)^{1/2}$	meters ^{1/2}
T_{oe}	sec
Fit Interval Flag	boolean
AODO	sec
C_{is}	radians
I_0	semi-circles
C_{rc}	meters
omega	semi-circles
OMEGAdot	semi-circles/sec
ldot	semi-circles/sec

The generated navigation file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0. The file contains one row per satellite that was assigned in the "Assistance Data Generation" dialog.

See section [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27 for description of the workflow for generation of assistance data.

SCPI command:

`<subsystem>:ADGeneration:NAVigation:CREate` on page 189

Generate UTC File ...

Opens the "Select UTC" File window for saving the generated UTC file. The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated UTC file is a file with extension `.rs_utc`.

The file contains all standard UTC parameters (SatID, A_0, A_1, delta_t_LS, t_ot, WN_t, WN_LSF, DN, and Delta_t_LSF) that are necessary to transform GPS time to the normal UTC time.

The generated UTC file contains one entry per standard.

See [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27 for description of the workflow for generation of assistance data.

SCPI command:

`<subsystem>:ADGeneration:UTC:CREate` on page 189

Generate Acquisition File ...

Opens the "Select Acquisition File" window for saving the generated acquisition file. The name of the file is specified in the "File name" entry field. To save the file, press the "Save" button.

The generated Acquisition file is a file with extension `.rs_acq`.

This file consists of one or more rows, each corresponding to the Receiver Referenced GPS Time of Week (GPS TOW). The number of generated rows depends on the settings made for in the "Assistance Data Generation" dialog and is calculated as follow:

Number Of Generated Rows = "Duration Of Assistance Data" / "Resolution of Assistance Data"

Each row includes several sequential acquisition blocks; each block comprises the parameters listed in [table 3-19](#). The number of the acquisition blocks depends on the number of the selected space vehicles in the "Assistance Data Generation" dialog.

The generated navigation file is conformed to the format appended to standards 3GPP 34.108 v.8.0.0 and 3GPP TS 51.010-1v.7.7.0.

Table 3-19: Contents of the generated acquisition file

Parameter	Unit
SatID	-
Doppler (0 th order term)	Hz
Doppler (1 st order term)	Hz/sec
Doppler Uncertainty	Hz
Code Phase	chips
Integer Code Phase	-
GPS Bit Number	-
Code Phase Search Window	chips
Azimuth	deg
Elevation	deg

See [chapter 2.8.7, "Generating GPS Assistance Data"](#), on page 27 for description of the workflow for generation of assistance data.

SCPI command:

`<subsystem>:ADGeneration:ACquisition:CREate` on page 188

3.11 Real-Time S.P.O.T.



The parameters of the "Real-Time S.P.O.T." are only configurable for R&S SMBV instruments.

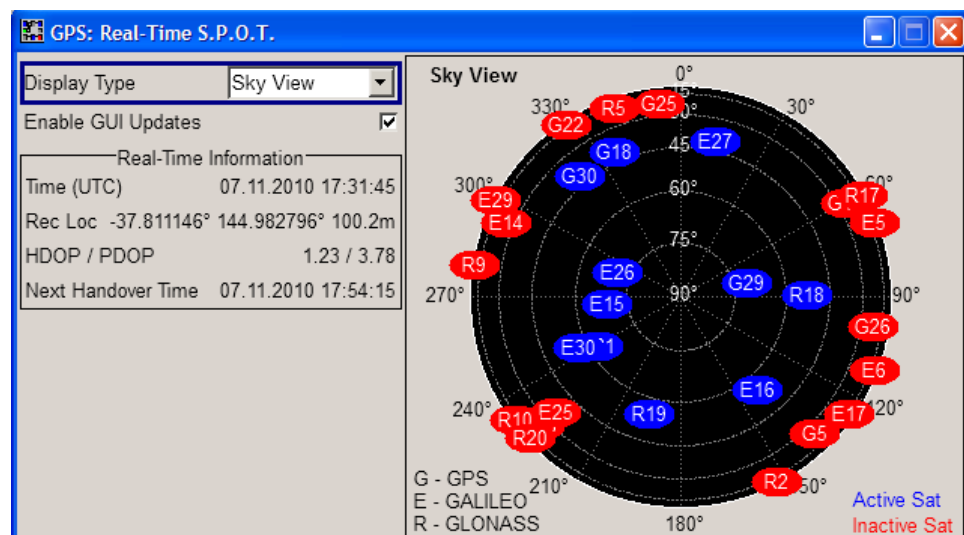
The "Real-Time S.P.O.T." (Satellites and Position Online Tracker) view is a dynamic display of the current satellite's constellation, receiver position, power levels of the active satellites.

The display is enabled for "Auto Localization" and "User Localization" modes.

The "Real-Time S.P.O.T." view provides dynamic real-time information about several parameters like HDOP, PDOP, receiver's location and current simulation time.

The displayed settings are grouped into four views, the "Sky View", the "Map View", the "Power View" and the "Trajectory View".

- The "Sky View" displays the current position and state (active or inactive) of the satellites in the current satellites constellation. When "Auto Localization" mode is selected, the situation of disappearance and re-appearance of satellites can be observed.

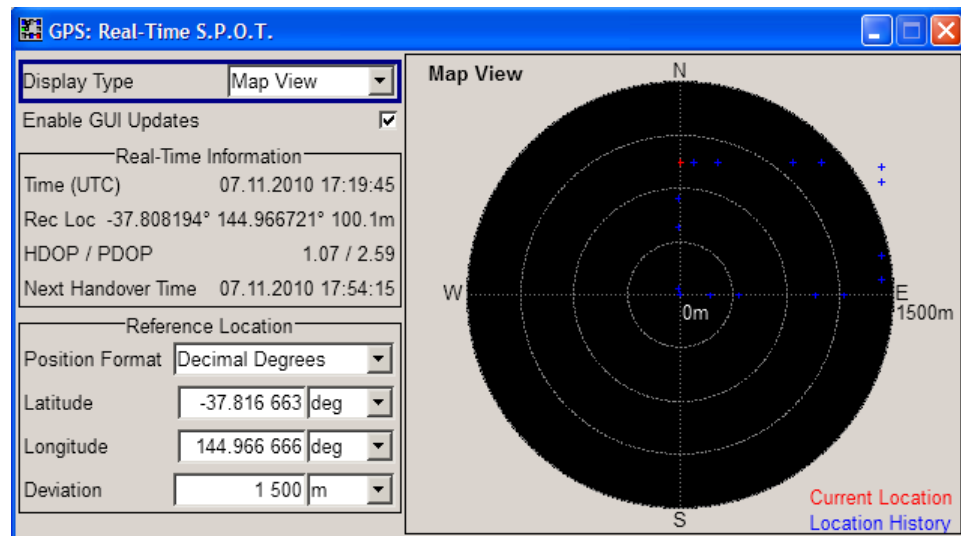


G = denotes GPS Satellite
 E = denotes Galileo Satellite
 R = denotes GLONASS Satellite

To query the satellite's constellation for the selected time, use the SCPI command:

`<subsystem>:RT:SCONstellation` on page 199

- The "Map View" display the trajectory of moving receiver or the position of a static one.



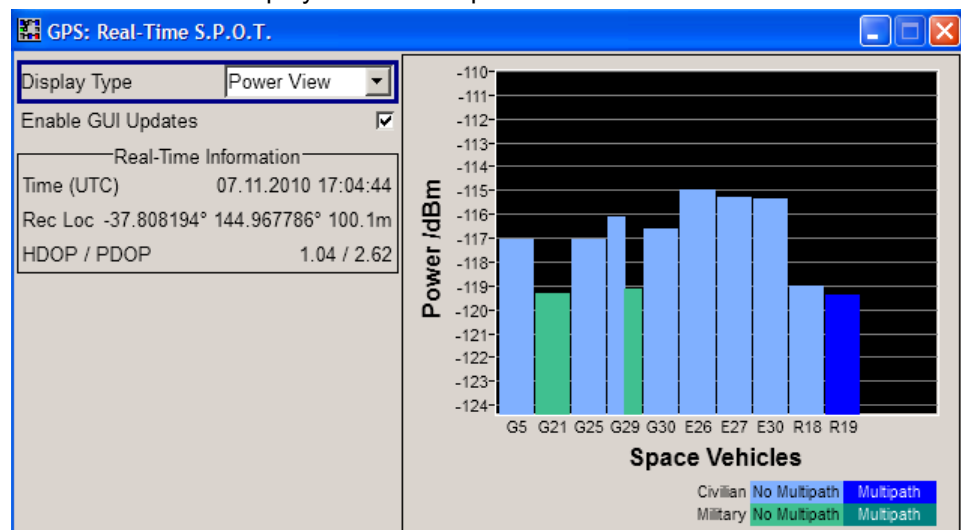
The "Real-Time S.P.O.T." display is updated every 5 second and a special dynamic time tuning algorithm is used to optimize the presentation of the "Map View" display. However, if GPS receiver software is used to analyze the generated GPS signal, a slight difference between the receiver position displayed on the "Map View" and the position displayed on the receiver software may be noticed at the beginning of a simulation. This accuracy of the "Map View" display is progressively increasing with the time elapsed and after the first satellite handover the deviation should completely disappear.

To query the receiver location for the selected time, use the SCPI commands:

`<subsystem>:RT:RLOCation:COORDinates:DECimal` on page 195

`<subsystem>:RT:RLOCation:COORDinates:DMS` on page 197

- The "Power View" displays the current power levels of the active satellites.

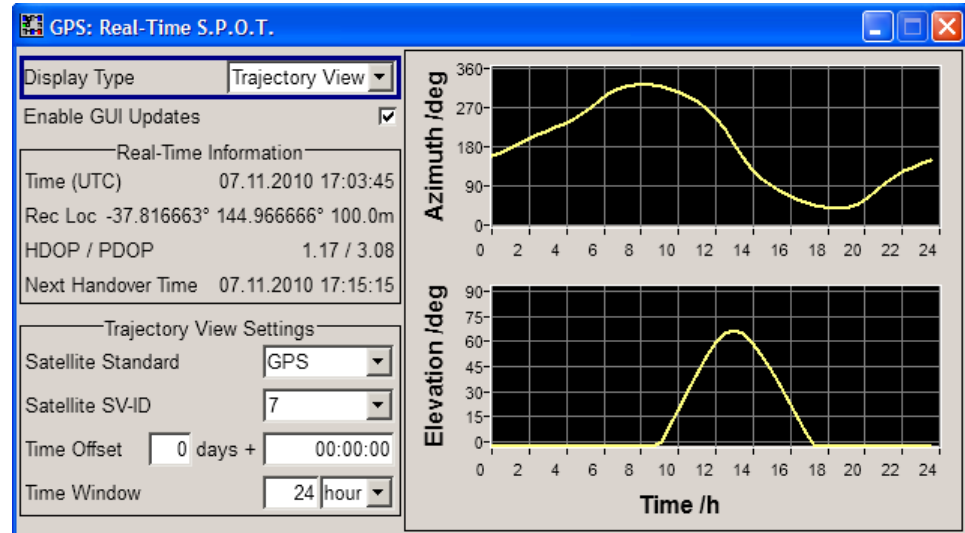


To query the satellite's absolute power for the selected time, use the SCPI command:

`<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute`

on page 194

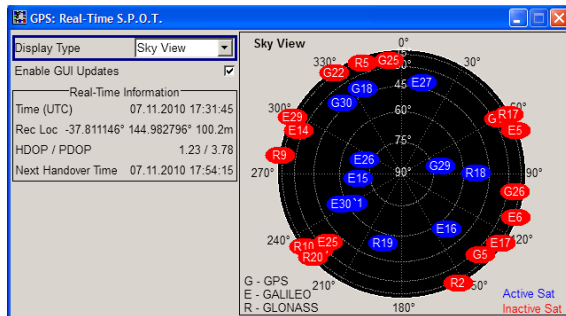
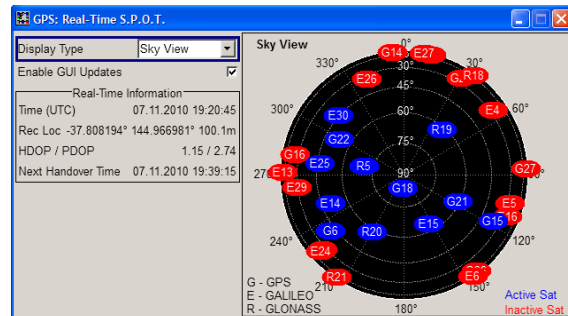
- The "Trajectory View" displays the time variation of the azimuth and the satellite's elevation in the selected time window.



To query the satellite's position for the selected time, use the SCPI commands:

`<subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth` on page 191

`<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation` on page 192

Example:**Sky View****Map View**

The figures in this section show the "Real-Time S.P.O.T. > Sky View" display of the same custom build GPS, Galileo and GLONASS hybrid scenario with automatic exchange of the satellites but the second one is made around two hours later (compare the value of the parameter "Time" in both figures).

The "Map View" shows the current position of the receiver which in this particular case is a moving receiver with "Read Out Mode" set to "Round Trip" (compare both map view trajectories, the receiver on the first one is moving clockwise and on the second one counterclockwise).

The current position and state of the satellites is displayed on the "Sky View". This is a hybrid scenario with 12 satellites. Compare the satellite constellations, the position and number of active and inactive satellites; some satellites had disappeared behind the horizon.

3.11.1 Display Type**Display Type**

Switches between the available views. See [chapter 3.11, "Real-Time S.P.O.T."](#), on page 97.

SCPI command:

n.a

Enable GUI Update

Enables/disables the GUI updates.

The update of the real time S.P.O.T. display information is very time consuming operation and could affect the instrument performance. This affects especially the remote control.

SCPI command:

`<subsystem>:SPOT:UPDate` on page 190

3.11.2 Real-Time Information

The "Real-Time Information" section is common for all views and provides dynamic real-time information about several parameters like "HDOP", "PDOP", "Receiver Location", "Elapsed Time" and "Time of Simulation".

Time (UTC)

Displays the current date and time of the simulation. The value is displayed in format DD.MM.YYY HH:MM:SS and is updated every 5 sec.

SCPI command:

n.a

Receiver Location

Displays the current location of the receiver in decimal format.

For static [Geographic Location](#), the "Receiver Location" is as selected in the "Localization Data" section of the main menu.

For moving receivers however, the receiver position specified in the "Localization Data" section of the main dialog is the initial location of the receiver. The current receiver location is retrieved from the waypoints file as function of the simulation "Time" and displayed in the "Real-Time S.P.O.T. > Map View" display.

SCPI command:

n.a

HDOP / PDOP

Displays the current HDOP and PDOP value of the selected satellite constellation.

The HDOP (Horizontal Dilution of Precision) can be used as an indication of 2D positioning quality. The PDOP (Position Dilution of Precision) can be used as an indication of 3D positioning quality.

The general rule here is that the smaller the HDOP and PDOP are, the better the precision of the position fix will be.

SCPI command:

n . a .

Get Next Handover Time

(enabled for "Auto Localization" mode)

Displays the expected date and time of the upcoming satellites handover.

SCPI command:

[<subsystem>:SPOT:NHOTime](#) on page 190

3.11.3 Reference Location

The "Reference Location" section is enabled in "Map View" display and provides the settings for configuration of the reference location.

Reference Location Coordinates

The reference location is identified by a latitude and a longitude. The values can be displayed in decimal or DMS format. The display format is determined by the parameter "Position Format".

For static receivers, the initial values of the latitude and longitude are automatically set to the values of the [Geographic Location](#) selected in the Localization Data section of the main dialog. When simulating moving receivers, the initial values are derived from the waypoints file and set to the coordinates of the first receiver position.

Parameter	Description
"Position Format"	<p>Sets the format in which the Latitude and Longitude are displayed.</p> <ul style="list-style-type: none"> "DEG:MIN:SEC" The display format is Degree:Minute:Second and Direction, i.e. <code>XX°XX'XX.XX" Direction</code>, where direction can be North/South and East/West. "Decimal Degree" The display format is decimal degree, i.e. <code>+/-XX.XXXXX°</code>, where "+" indicates North and East and "-" indicates South and West. <p>The Position Format selected here changes the format the Receiver Location is displayed.</p>
"Latitude"	Sets the latitude of the reference location.
"Longitude"	Sets the longitude of the reference location.

SCPI command:

n.a

Deviation

Sets the deviation in terms of meters from the Reference Location and determines the radius of the "Map View" display.

SCPI command:

n . a .

3.11.4 Trajectory View Settings

This settings section is available in the "Trajectory View" display and comprises the settings for customization of the displayed Azimuth and Elevation trajectories.

Satellite Standard

Determines the navigation standard the [Satellite SV-ID](#) is belonging to.

SCPI command:

determined by the `<GNSS>` block of the SCPI command

Satellite SV-ID

Determines the SV-ID of the satellite for that the Azimuth and Elevation trajectories are displayed.

SCPI command:

determined by the suffix in the `SVID<ch>` block of the SCPI command

Time Offset

Determines the time offset as number of days and number of hours.

SCPI command:

n.a.

Time Window

Sets the time window the trajectories are displayed in, i.e. determines the resolution of the x-axis of the Trajectory View.

SCPI command:

n.a.

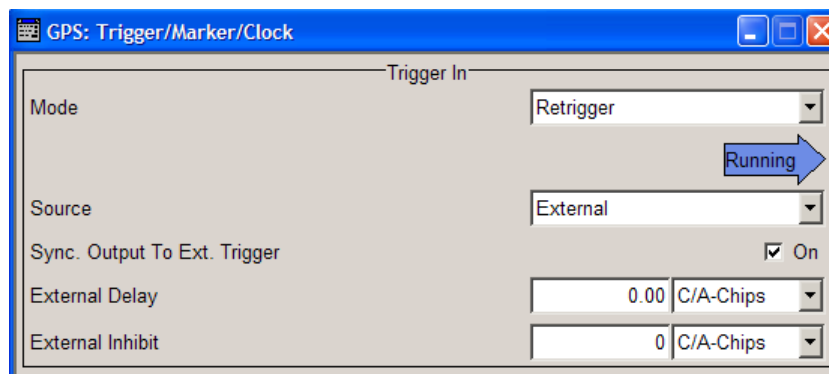
3.12 Trigger/Marker/Clock Settings

To access this dialog, select "Main Dialog > Trigger/Marker".



The trigger and clock functions are available for R&S SMBV instruments only.

The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.



The "Marker Mode" section is where the marker signals at the MARKER output connectors are configured.

The "Marker Delay" section is where a marker signal delay can be defined, either without restriction or restricted to the dynamic section, i.e., the section in which it is possible to make settings without restarting signal and marker generation.

The screenshot shows two sections: "Marker Mode" and "Marker Delay".

Marker Mode:

- Marker 1: 1PPS (GPS), Pulse Width: 1 C/A-Chips
- Marker 2: On/Off Ratio, On Time: 1 C/A-Chips, Off Time: 1 C/A-Chips

Marker Delay:

- Marker 1: 0 C/A-Chips
- Marker 2: 0 C/A-Chips
- Current Range Without Recalculation: 0 to 2000 C/A-Chips (visualized with a scale and a yellow triangle marker)
- Fix Marker Delay To Current Range:

The "Clock Settings" section is where the clock source is selected and - in the case of an external source - the clock type.

The buttons in the last section lead to the submenu for general trigger, clock and mapping settings.

The screenshot shows the "Clock Settings" section with the following parameters:

- Sync Mode: None
- Clock Source: External
- Clock Mode: Multiple Sample
- Chip Clock Multiplier: 4
- Measured External Clock: 0.000 Hz

A button labeled "Global Trigger/Clock Settings..." is located at the bottom left.

3.12.1 Trigger In

The "Trigger In" section is where the trigger for the signal is set. Various parameters will be provided for the settings, depending on which trigger source - internal or external - is selected. The current status of signal generation ("Running" or "Stopped") is indicated for all trigger modes.

Trigger Mode

Selects trigger mode.

The trigger mode determines the effect of a trigger on the signal generation.

"Auto" The signal is generated continuously.

"Retrigger" The signal is generated continuously. A trigger event (internal or external) causes a restart.

"Armed_Auto"	The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.
"Armed_Retrigger"	The signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart. Button "Arm" stops signal generation. A subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.
"Single"	The signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified at "Signal Duration". Every subsequent trigger event (internal with "Execute Trigger" or external) causes a restart.

SCPI command:

[<subsystem>\[:TRIGger\]:SEQuence](#) on page 202

Signal Duration

Defines the length of the signal sequence to be output in the "Single" trigger mode.

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

SCPI command:

[<subsystem>:TRIGger:SLENgth](#) on page 203

Running/Stopped

Displays the status of signal generation for all trigger modes. This display appears only when signal generation is enabled ("State" On).

"Running"	The modulation signal is generated; a trigger was (internally or externally) initiated in triggered mode. If "Armed_Auto" and "Armed_Retrigger" have been selected, generation of signals can be stopped with the "Arm" button. A new trigger (internally with "Execute Trigger" or externally) causes a restart.
"Stopped"	The signal is not generated, and the instrument waits for a trigger event (internal or external).

SCPI command:

[<subsystem>:TRIGger:RMODe](#) on page 204

Arm

(R&S SMBV only)

Stops signal generation. This button appears only with "Running" signal generation in the "Armed_Auto" and "Armed_Retrigger" trigger modes.

Signal generation can be restarted by a new trigger (internally with "Execute Trigger" or externally).

SCPI command:

[<subsystem>:TRIGger:ARM:EXECute](#) on page 204

Execute Trigger

(R&S SMBV only)

Executes trigger manually. A manual trigger can be executed only when an internal trigger source and a trigger mode other than "Auto" have been selected.

SCPI command:

`<subsystem>:TRIGger:EXECute` on page 205

Trigger Source

Selects trigger source. This setting is effective only when a trigger mode other than "Auto" has been selected.

"Internal" The trigger event is executed by "Execute Trigger".

"External" The trigger event is executed with the aid of the active edge of an external trigger signal.

The trigger signal is supplied via the TRIGGER connector. The polarity, the trigger threshold and the input impedance of the TRIGGER input can be set in the "Global Trigger/Clock Settings" dialog.

SCPI command:

`<subsystem>:TRIGger:SOURce` on page 205

Sync. Output to External Trigger

(enabled for Trigger Source External)

Enables/disables output of the signal synchronous to the external trigger event.

For one or two or more R&S SMBVs configured to work in a master-slave mode for synchronous signal generation, configure this parameter depending on the provided system trigger event and the properties of the output signal. See the table below for an overview of the required settings.

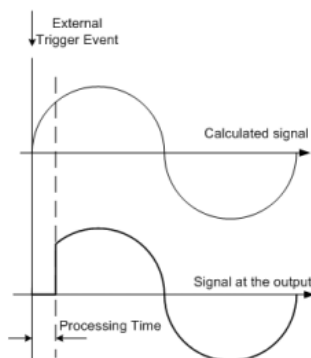
Table 3-20: Typical Applications

System Trigger	Application	"Sync. Output to External Trigger"
Common External Trigger event for the master and the slave instruments	All instruments are synchronous to the external trigger event	ON
	All instruments are synchronous among themselves but starting the signal from first symbol is more important than synchronicity with external trigger event	OFF
Internal trigger signal of the master R&S SMBV for the slave instruments	All instruments are synchronous among themselves	OFF

"On"

Corresponds to the default state of this parameter.

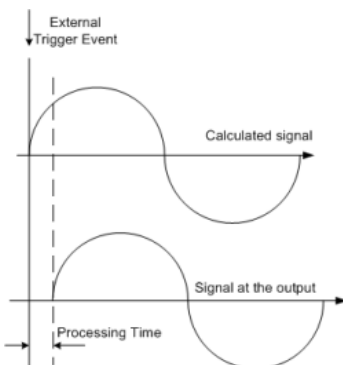
The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.



"Off"

The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.

This mode is recommended for triggering of short signal sequences with signal duration comparable with the processing time of the instrument.



SCPI command:

[<subsystem>:TRIGger:EXTernal:SYNChronize:OUTPut](#) on page 205

External Delay

Sets the trigger signal delay in chips on external triggering. This enables the instrument to be synchronized with the device under test or other external devices.

SCPI command:

[<subsystem>:TRIGger\[:EXTernal<ch>\]:DELay](#) on page 207

External Inhibit

Sets the duration for inhibiting a new trigger event subsequent to triggering. The input is to be expressed in chips.

In the "Retrigger" mode, every trigger signal causes signal generation to restart. This restart is inhibited for the specified number of chips.

SCPI command:

`<subsystem>:TRIGger[:EXternal<ch>]:INHibit` on page 207

3.12.2 Marker Mode

The marker output signal for synchronizing external instruments is configured in the marker settings section "Marker Mode".

Marker Mode

Selects a marker signal for the associated "MARKER" output.

Note: One marker signal. In instruments equipped with option R&S SMBV-K96, disabled parameter [Use Military GPS \(P\)](#) and enabled satellites constellation with more than 12 satellites, only one marker signal is available!

- | | |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "Restart" | (R&S WinIQSIM2 only)
A marker signal is generated continuously. A trigger event causes a restart.
This marker marks one repetition of the ARB and hence depends on "Duration Of Satellite Simulation". |
| "1PPS" | A marker signal is generated for every start of second. The used time basis is displayed right to the field.
The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips. |
| "10PPS" | A marker signal is generated ten times per second hence once every 100 ms. |
| "1PP2S" | A marker signal is generated for every second start of second. The used time basis is displayed right to the field.
The "Pulse Width" is set in the corresponding field. The input is expressed as a number of chips. |

SCPI command:

`<subsystem>:TRIGger:OUTPut<ch>:PULSe:WIDTh` on page 211

- | | |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "Pulse" | A regular marker signal is generated. The clock frequency is defined by entering a divider. The frequency is derived by dividing the chip rate by the divider. The input box for the divider opens when "Pulse" is selected, and the resulting pulse frequency is displayed. |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

SCPI command:

`<subsystem>:TRIGger:OUTPut<ch>:PULSe:DIVider` on page 210

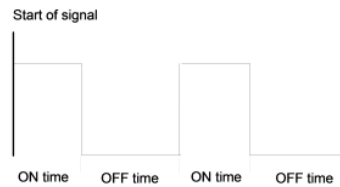
`<subsystem>:TRIGger:OUTPut<ch>:PULSe:FREQuency` on page 210

- | | |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| "Pattern" | A marker signal that is defined by a bit pattern is generated. The pattern has a maximum length of 32 bits and is defined in an input field which opens when pattern is selected. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

SCPI command:

`<subsystem>:TRIGger:OUTPut<ch>:PATtern` on page 210

"ON/OFF Ratio" A regular marker signal that is defined by an ON/OFF ratio is generated. A period lasts one ON and OFF cycle. The "ON Time" and "OFF Time" are each expressed as a number of samples and are set in an input field which opens when ON/OFF ratio is selected.



SCPI command:

[<subsystem>:TRIGger:OUTPut<ch>:ONTime](#) on page 209

[<subsystem>:TRIGger:OUTPut<ch>:OFFTime](#) on page 209

"Trigger" A marker signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

SCPI command:

[<subsystem>:TRIGger:OUTPut<ch>:MODE](#) on page 208

3.12.3 Marker Delay

The delay of the signals on the MARKER outputs is set in the "Marker Delay" section.

Marker x Delay

Enters the delay between the marker signal at the marker outputs and the start of the frame or slot.

The input is expressed as a number of chips. If the setting "Fix marker delay to dynamic range" is enabled, the setting range is restricted to the dynamic range. In this range the delay of the marker signals can be set without restarting the marker and signal.

SCPI command:

[<subsystem>:TRIGger:OUTPut<ch>:DELAy](#) on page 206

Current Range without Recalculation

Displays the dynamic range within which the delay of the marker signals can be set without restarting the marker and signal.

The delay can be defined by moving the setting mark.

SCPI command:

[<subsystem>:TRIGger:OUTPut<ch>:DELAy:MINimum](#) on page 206

[<subsystem>:TRIGger:OUTPut<ch>:DELAy:MAXimum](#) on page 206

Fix marker delay to current range

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal.

SCPI command:

[<subsystem>:TRIGger:OUTPut:DELAy:FIXed](#) on page 207

3.12.4 Clock Settings

The Clock Settings is used to set the clock source and a delay if required.

Sync. Mode

Selects the synchronization mode.

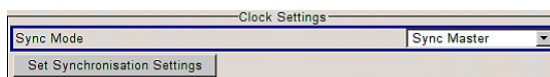
This parameter is used to enable generation of very precise synchronous signal of several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave one and between each two consecutive slave instruments must have the same length and type.

Avoid unnecessary cable length and branching points.

"None" The instrument is working in stand-alone mode.

"Sync. Master" The instrument provides all connected instrument with its synchronisation (including the trigger signal) and reference clock signal.



"Sync. Slave" The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

SCPI command:

[<subsystem>:CLOCK:SYNChronization:MODE](#) on page 213

Set Synchronization Settings

Performs automatic adjustment of the instrument's settings required for the synchronization mode, selected with the parameter "Synchronization Mode".

SCPI command:

[<subsystem>:CLOCK:SYNChronization:EXECute](#) on page 213

Clock Source

Selects the clock source.

"Internal" The internal clock reference is used to generate the symbol clock.

"External" The external clock reference is fed in as the symbol clock or multiple thereof via the CLOCK connector. The symbol rate must be correctly set to an accuracy of +/-2 % (see data sheet).
The polarity of the clock input can be changed with the aid of "Global Trigger/Clock Settings".

SCPI command:

[<subsystem>:CLOCK:SOURce](#) on page 212

Clock Mode

Enters the type of externally supplied clock.

"Chip" A chip clock is supplied via the CLOCK connector.

"Multichip" A multiple of the chip clock is supplied via the CLOCK connector; the sample clock is derived internally from this. The "Multiplier" window provided allows the multiplication factor to be entered.

SCPI command:

`<subsystem>:CLOCK:MODE` on page 211

Clock Multiplier

Enters the multiplication factor for clock type "Multiple".

SCPI command:

`<subsystem>:CLOCK:MULTIPLIER` on page 212

Measured External Clock

Indicates the measured frequency of the external clock signal. This enables the user to permanently monitor the frequency of the externally introduced clock.

This information is displayed only if the external clock source has been selected.

SCPI command:

`CLOCK:INPUT:FREQUENCY?`

3.12.5 Global Settings

The buttons in this section lead to submenu for general trigger, clock and mapping settings.

Global Trigger/Clock Settings

Calls the "Global Trigger/Clock/Input Settings" dialog.

This dialog is used among other things for setting the trigger threshold, the input impedance and the polarity of the clock and trigger inputs.

The parameters in this menu affect all digital modulations and standards, and are described in chapter "Global Trigger/Clock/Input Settings" in the Operating Manual.

4 Remote-Control Commands

The `SOURce:BB:GPS|GALileo|GLONass` subsystem contains commands for configuring the GNSS standards.

Placeholder <Subsystem>

To simplify the description of the remote control commands, the placeholder <Subsystem> is introduced. Depending on the navigation standard used as an entry standard, replace this placeholder <Subsystem> with `SOURce:BB:GPS`, `SOURce:BB:GALileo` (for Galileo) or `SOURce:BB:GLONass` (for GLONASS).



The replacement of the placeholder <Subsystem> is mandatory, i.e. remote control commands containing this placeholder are not recognized and accepted by the instrument.

Example:

SCPI command: `<subsystem>:STATe`

- Entry Standard = GPS
`SOUR:BB:GPS:STAT`
- Entry Standard = Galileo
`SOUR:BB:GAL:STAT`
- Entry Standard = GLONASS
`SOUR:BB:GLON:STAT`
- invalid command
`<Subsystem>:STAT`

Placeholder <GNSS>

The placeholder <GNSS> is introduced to simplify the description of group of commands with similar syntax. Depending on the navigation standard to be controlled, replace this placeholder <GNSS> with `GPS` or `GALileo`.

Example:

SCPI command: `<subsystem>:HYBRid:<GNSS>[:STATe]`

- Entry Standard = GPS
replace the placeholder <subsystem> with `SOUR:BB:GPS`
- In a hybrid configuration, the navigation standard of the entry point (GPS) is always enabled. To enable the Galileo satellites, replace the placeholder <GNSS> with `GALileo`
`SOUR:BB:GPS:HYBR:GAL:STAT`
- invalid commands
`<Subsystem>:HYBR:GAL:STAT`
`SOUR:BB:GPS:HYBR:<GNSS>:STAT`

`SOURce<hw>`

For one-path instruments, the keyword `SOURce` is optional and can be omitted.

The numeric suffix to `SOURce` distinguishes between signal generation for path A and path B in the case of two-path instruments:

- `SOURce[1]` = path A
The keyword `SOURce` is optional and can be omitted
- `SOURce2` = path B
The keyword `SOURce` is mandatory, i.e. the command must contain the keyword with suffix 2.

OUTPut<ch>

The numeric suffix to `OUTPut` distinguishes between the available markers.

Only two markers are available for the R&S SMBV, i.e. the allowed values for the suffix are 1 or 2.

4.1 Primary Settings

The following examples use GPS entry standard.

Example: Save/Recall Files with user settings

SCPI Command	Response
<code>BB:GPS:SETT:CAT? '/var/user/settings'</code>	<code>gps_settings,settings</code>
<code>BB:GLO:SETT:CAT? '/var/user/settings'</code>	<code>glo_settings,settings</code>
<code>BB:GAL:SETT:CAT? '/var/user/settings'</code>	<code>gal_settings,settings</code>
	There are four files in the <code>/var/user/settings</code> directory: <code>gps_settings.gps</code> , <code>settings.gps</code> , <code>gal_settings.galileo</code> and <code>settings.galileo</code> .
<code>BB:GPS:SETT:STOR '/var/user/settings/gps_settings_new'</code>	
<code>BB:GPS:SETT:LOAD '/var/user/settings/gps_settings'</code>	
<code>BB:GPS:SETT:DEL '/var/user/settings/settings'</code>	
Deletes the file <code>settings.gps</code> .	
<code>BB:GPS:SETT:CAT? '/var/user/settings'</code>	<code>gps_settings</code>
<code>BB:GAL:SETT:CAT? '/var/user/settings'</code>	<code>gal_settings,settings</code>

Example: Selecting a predefined test scenario

```
BB:GPS:PRES
```

```
BB:GPS:ATSC W3GPER2
```

selects the predefined A-GPS test scenario 3GPP FDD Performance Test Scenario 2

```
BB:GPS:STAT ON
```

<subsystem>:PRESet.....	114
<subsystem>:STATe.....	114
<subsystem>:RFBand.....	115
<subsystem>:PRFFrequency.....	115
<subsystem>:SMODE.....	115
[:SOURce<hw>]:BB:GPS:ATSCenario.....	115
<subsystem>:SETTing:CATalog.....	116
[:SOURce<hw>]:BB:GALileo:SETTing:CATalog.....	116
[:SOURce<hw>]:BB:GLONass:SETTing:CATalog.....	117
[:SOURce<hw>]:BB:GPS:SETTing:CATalog.....	117
<subsystem>:SETTing:STORE.....	117
<subsystem>:SETTing:STORE:FAST.....	117
<subsystem>:SETTing:LOAD.....	117
<subsystem>:SETTing:DELeTe.....	118
<subsystem>:DURation.....	118
<subsystem>:FILTer:OSAMpling.....	118
<subsystem>:WAVEform:CREate.....	119

<subsystem>:PRESet

Restores the default settings. The default values correspond to the *RST values in the descriptions of the SCPI commands.

Example: See [example "Selecting a predefined test scenario"](#) on page 114.

Usage: Event

<subsystem>:STATE <State>

Enables/disables the GNSS signal simulation.

Enabling this standard disables all the other digital standards and digital modulation modes.

A continuous GNSS signal is generated for up to 24 satellites in real time mode. The number is determined by the command `<subsystem>:SATellite:COUNT` and the maximum value depends on the installed SW options.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: See [example "Selecting a predefined test scenario"](#) on page 114.

<subsystem>:RFBand <RfBand>

Selects the center carrier frequency of the instrument.

Parameters:

<RfBand> L1 | L2

Available values depend on selected standard; for an overview see "[RF Band](#)" on page 40

*RST: L1

Example:

BB:GPS:RFB L1

BB:GPS:PRFL

sets the RF level to 1.575420 GHz

Example:

BB:GAL:RFB L1

selects the Galileo E1 RF band

BB:GAL:PRFL

sets the RF level to 1.575420 GHz

<subsystem>:PRFFrequency

Sets the RF frequency in the "Frequency" display in the header of the instrument to the carrier frequency.

Tip: The carrier frequency is calculated automatically and for hybrid signals may deviate from the frequency set with the command `<subsystem>:RFBand`.

Example:

BB:GPS:RFB L1

BB:GPS:PRFL

sets the RF level to 1.575420 GHz

Usage:

Event

<subsystem>:SMODE <SMode>

Sets the simulation mode.

Parameters:

<SMode> STATic | AUTO | USER

Refer to "[Simulation Mode](#)" on page 41 for description of the simulation modes.

*RST: STATic

[:SOURCE<hw>]:BB:GPS:ATSCenario <Scenario>

Selects the file with the predefined A-GPS test scenario.

Parameters:

<Atscenario>

USER | GSMSIG | GSMPER1 | GSMPER2 | GSMPER3 |
W3GSIG | W3GPER1 | W3GPER2 | W3GPER3 | W3G2S |
W3G2M

User

No predefined test scenario is selected.

GSMSIG

Predefined A-GPS GSM Signalling Scenario
(3GPP TS 51.010-1 v.7.7.0)

GSMPER1

Predefined A-GPS GSM Performance Test Scenario 1
(3GPP TS 51.010-1 v.7.7.0)

GSMPER2

Predefined A-GPS GSM Performance Test Scenario 2
(3GPP TS 51.010-1 v.7.7.0)

GSMPER3

Predefined A-GPS 3GPP FDD Performance Test Scenario 3
(3GPP TS 51.010-1 v.7.7.0)

W3GSIG

Predefined A-GPS 3GPP FDD Signalling Scenario
(3GPP 34.108 v.8.0.0, 3GPP TS 34.123-3 v.6.4.0)

W3GPER1

Predefined A-GPS 3GPP FDD Performance Test Scenario 1
(3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

W3GPER2

Predefined A-GPS 3GPP FDD Performance Test Scenario 2
(3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

W3GPER3

Predefined A-GPS 3GPP FDD Performance Test Scenario 3
(3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1)

W3G2S

Predefined A-GPS 3GPP2 Static Test Scenario
(3GPP2 C.S0036-0 V1.0)

W3G2M

Predefined A-GPS 3GPP2 MovingTest Scenario
(3GPP2 C.S0036-0 V1.0)

*RST: USER

Example:

See [example "Selecting a predefined test scenario"](#) on page 114.

<subsystem>:SETTING:CATalog

[:SOURce<hw>]:BB:GALileo:SETTING:CATalog?

[:SOURce<hw>]:BB:GLONass:SETTing:CATalog?

[:SOURce<hw>]:BB:GPS:SETTing:CATalog?

Reads out the files with GPS/Galileo settings in the default directory. The default directory is set using command `M MEM:CDIRectory`. Only files with the file extension `.gps`, `.galileo` or respectively `.glonass` are listed.

Return values:

<Catalog> string

Example: See [example "Save/Recall Files with user settings"](#) on page 113.

Usage: Query only

<subsystem>:SETTing:STORe <Filename>

Stores the current settings of the specified GNSS standard into the selected file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Configurations are stored with the predefined file extension `*.gps` (for GPS settings) or `*.galileo` (for Galileo settings).

Setting parameters:

<Filename> string

Example: See [example "Save/Recall Files with user settings"](#) on page 113.

Usage: Setting only

<subsystem>:SETTing:STORe:FAST <Fast>

Determines whether the instrument performs an absolute or a differential storing of the settings.

Enable this function to accelerate the saving process by saving only the settings with values different to the default ones.

Note: This function is not affected by the "Preset" function.

Parameters:

<Fast> 0 | 1 | OFF | ON
 *RST: 1

<subsystem>:SETTing:LOAD <Filename>

Loads the selected file with GPS or Galileo settings. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case files in the specified directory are read. Only files with the file extension `*.gps` or `.galileo` can be loaded.

Setting parameters:

<Filename> string

Example: See [example "Save/Recall Files with user settings"](#) on page 113.

Usage: Setting only

<subsystem>:SETTING:DELEte <Filename>

Deletes the selected file with GPS or Galileo settings. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case files in the specified directory are deleted. Only files with the file extension `.gps` or `.galileo` are deleted.

Setting parameters:

<Filename> string

Example: See [example "Save/Recall Files with user settings"](#) on page 113.

Usage: Setting only

<subsystem>:DURation <Duration>

Determines the duration of the satellite simulation.

The resulting duration of the simulation is calculated as follow:

$$\text{Duration of Simulation} = \frac{\text{Duration of Satellite Simulation}}{1 + \frac{\text{Doppler Shift}}{F_{\text{Carrier}}}}$$

where F_{Carrier} is the frequency selected with the parameter RF Band.

The maximum duration of satellite simulation depends on the Oversampling factor and the ARB memory size of the connected instrument.

Parameters:

<Duration> float
 Range: 20.0e-3 to 64
 Increment: 20.0e-3
 *RST: 20.0e-3

Example: `SOUR:BB:GPS:DUR 20`
 sets 20 ms for the satellite simulation.

<subsystem>:FILTer:OSAMpling <OSampling>

Determines the upsampling factor.

A higher upsampling factor improves the filtering but increases the waveform size proportionally. This leads to limitation for the maximum "Duration Of Satellite Simulation".

Parameters:

<OSampling> integer
 Range: 2 to 32
 *RST: 2

<subsystem>:WAVeform:CREate <Filename>

(For R&S WinIQSIM2 only)

This command creates a waveform using the current settings of the GNSS dialog. The file is stored with the predefined file extension *.wv. The file name and the directory it is stored in are user-definable.

Setting parameters:

<Filename> string

Example:

MMEM:CDIR 'D:\user\waveform

sets the default directory.

BB:GPS:WAV:CRE 'gnss_1'

creates the waveform file gnss_1.wv in the default directory.

Usage: Setting only

4.2 Localization Data

The following example uses GPS entry standard.

Example: Selecting a waypoint file

SCPI Command	Response
BB:GPS:LOC:CAT?	User Defined,Waypoints,New York, San Francisco,Beijing,Seoul, Singapore,Taipei,Tokyo,Sydney, London,Munich,Paris,Moscow
BB:GPS:LOC:SEL "Waypoints"	
MMEM:CAT? '<root>/Lists/Gnss/Waypoints'	583768,52428800000,".,DIR,0", ".,DIR,0","3gpp2.txt,ASC, 233703","Melbourne.txt,ASC, 238949", "Melbourne_Movement.txt,ASC, 2104"
BB:GPS:LOC:WAYP:FILE '<root>/Lists/Gnss/Waypoints/Melbourne.txt'	
BB:GPS:LOC:ROM CYCL	
BB:GPS:LOC:COOR:DEC?	144.966658,-37.816663,100 the coordinates of the first simulation position defined in the selected movement file
BB:GPS:LOC:COOR:DMS?	144,57,59.970,EAST, 37,48,59.987,SOUT,100
<subsystem>:LOCation:CATalog	120
<subsystem>:LOCation[:SElect]	120
<subsystem>:LOCation:WAYPoints:FILE	120
<subsystem>:LOCation:WAYPoints:ROMode	121

<subsystem>:LOCation:COORdinateS:DECimal.....	121
<subsystem>:LOCation:COORdinateS:DMS.....	122

<subsystem>:LOCation:CATalog?

Queries the names of the predefined geographic locations.

Example: See [example "Selecting a waypoint file"](#) on page 119.

Usage: Query only

<subsystem>:LOCation[:SElect] <Location>

Selects the geographic location of the GNSS receiver.

For details see ["Geographic Location"](#) on page 43.

Parameters:

<Location> "User Defined" | "New York" | "San Francisco" | "Beijing" | "Seoul" | "Singapore" | "Taipei" | "Tokyo" | "Sydney" | "London" | "Moscow" | "Munich" | "Paris" | "Waypoints"

User Defined

Enables the definition of the "Latitude", "Longitude" and "Altitude" of the GNSS receiver with fixed position in the ECEF WGS84 coordinate system.

Waypoints

(requires option GNSS Enhancements R&S SMBV-K92)
Enables defining a moving scenario, i.e. the simulation of a moving receiver.

For details see ["Geographic Location"](#) on page 43.

"New York" | "San Francisco" | "Beijing" | "Seoul" | "Singapore" | "Taipei" | "Tokyo" | "Sydney" | "London" | "Moscow" | "Munich" | "Paris"

Selects one of the predefined fixed geographic locations (see [table 3-1](#)).

The parameters "Latitude", "Longitude" and "Altitude" are set according to the selected position.

Example: See [example "Selecting a waypoint file"](#) on page 119.

<subsystem>:LOCation:WAYPoints:FILE <WayPoints>

Selects a predefined waypoint file. A waypoint file must have the extension `.txt` or `.nmea`. See [chapter A, "Movement Files"](#), on page 214 for detailed description of the waypoint file's format.

This setting is only available if `<subsystem>:LOCation[:SElect]` is set to `Waypoints`.

Parameters:

<WayPoints> string

Example: See [example "Selecting a waypoint file"](#) on page 119.

Options: R&S SMBV-K92

<subsystem>:LOCation:WAYPoints:ROMode <RoMode>

Defines the way the waypoint file is to be read.

This setting is only available if `<subsystem>:LOCation[:SElect]` is set to `Waypoints`.

Parameters:

`<RoMode>` CYCLic | RTRip | OWAY

CYCLic

The waypoint file is read out cyclic.

Using this read out mode is only recommended for waypoint files that describe a circle moving scenario or moving scenario in which the start and the end point are close to each other.

OWAY (One Way)

The file is read out only once.

When the end of the file is reached, the last described position is assumed to be a static one.

RTRip (Round Trip)

When the end of the file is reached, the file is read out backwards.

*RST: OWAY

Example: See [example "Selecting a waypoint file"](#) on page 119.

Options: R&S SMBV-K92

<subsystem>:LOCation:COORDinates:DECimal <Longitude>, <Latitude>, <Altitude>

Defines the coordinates of the geographic location of the GNSS receiver in decimal format.

Parameters:

`<Longitude>` float
 Range: -180 to 180
 Increment: 1E-6
 *RST: 0

`<Latitude>` float
 Range: -90 to 90
 Increment: 1E-6
 *RST: 0

`<Altitude>` float
 Altitude in meters above sea level.
 Range: -10000 to 1600000
 Increment: 0.1
 *RST: 0

Example: See [example "Selecting a waypoint file"](#) on page 119.

<subsystem>:LOCation:COORDinates:DMS <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

Defines the coordinates of the geographic location of the GNSS receiver in degrees, minutes and seconds.

Parameters:

<LongitudeDeg>	integer	Defines the longitude degrees. Range: 0 to 180 Increment: 1 *RST: 0
<LongitudeMin>	integer	Defines the longitude minutes. Range: 0 to 59 Increment: 1 *RST: 0
<LongitudeSec>	float	Defines the longitude seconds. Range: 0 to 59.999 Increment: 0.001 *RST: 0
<LongitudeDir>	EAST WEST	Defines the longitude direction. *RST: EAST
<LatitudeDeg>	integer	Defines the latitude degrees. Range: 0 to 90 Increment: 1 *RST: 0
<LatitudeMin>	integer	Defines the latitude minutes. Range: 0 to 59 Increment: 1 *RST: 0
<LatitudeSec>	float	Defines the latitude seconds. Range: 0 to 59.999 Increment: 0.001 *RST: 0

<LatitudeDir>	NORTH SOUTH Defines the latitude direction. *RST: NORT
<Altitude>	float Defines the altitude in meters above sea level. Range: -10000 to 1600000 Increment: 0.1 *RST: 0

Example: See [example "Selecting a waypoint file"](#) on page 119.

4.3 Navigation Data

The following example uses GPS entry standard.

Example: Selecting Real Navigation Data

SCPI Command	Response
BB:GPS:NAV:DATA RND	
BB:GPS:NAV:ALM:GPS:FILE '<root>/Lists/GNSS/GPS/Almanacs/GPS_SEM585.txt'	
BB:GPS:NAV:SIM:TBAS UTC	
BB:GPS:NAV:SIM:DATE?	2008,7,13
BB:GPS:NAV:SIM:TIME?	17,4,0
BB:GPS:NAV:SIM:TBAS GPS	
BB:GPS:NAV:SIM:WNUM?	1488
BB:GPS:NAV:SIM:TOW?	61455
<subsystem>:NAVigation:DATA.....	123
<subsystem>:NAVigation:DATA:DSElect.....	124
<subsystem>:NAVigation:DATA:PATtern.....	124
<subsystem>:NAVigation:SIMulation:TBASis.....	125
<subsystem>:NAVigation:SIMulation:DATE.....	125
<subsystem>:NAVigation:SIMulation:TIME.....	125
<subsystem>:NAVigation:SIMulation:WNUMber.....	126
<subsystem>:NAVigation:SIMulation:TOWeek.....	126

<subsystem>:NAVigation:DATA <Data>

Determines the data source for the navigation information.

Parameters:

<Data> ZERO | ONE | PATtern | PN9 | PN11 | PN15 | PN16 | PN20 |
PN21 | PN23 | DLISt | RNDData

RNDData

Real navigation data provided by an almanac file is used. The file is loaded with command `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

DLISt

A data list is used. The data list is selected with the command `<subsystem>:NAVigation:DATA:DSElect`.

PNxx

The pseudo-random sequence generator is used as the data source. Different random sequence lengths can be selected.

ZERO | ONE

Internal 0 and 1 data is used

PATtern

Internal data is used. The bit pattern for the data is defined by the command `<subsystem>:NAVigation:DATA:PATtern`.

*RST: RNDData

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

<subsystem>:NAVigation:DATA:DSElect <DSelect>

Selects the data list for `<subsystem>:NAVigation:DATA:DLISt`.

The lists are stored as files with the fixed file extensions `*.dm_iqd` in a directory of the user's choice. The directory applicable to the following commands is defined with the command `MMEMory:CDIR`. To access the files in this directory, you only have to give the file name, without the path and the file extension.

Parameters:

<DSelect> string

Example:

```
BB:GPS:NAV:DATA DLIS
BB:GPS:NAV:DATA:DLIS '<root>/Lists/GNSS_list1'
selects file 'GNSS_list1' as the data source. This file must be in
the directory <root>/Lists and have the file extension
*.dm_iqd.
```

<subsystem>:NAVigation:DATA:PATtern <Pattern>

Determines the bit pattern for `<subsystem>:NAVigation:DATA:PATtern`. The maximum length is 64 bits.

Parameters:

<Pattern> 64 bit pattern
*RST: 0

Example: BB:GPS:NAV:DATA PATT
BB:GPS:NAV:DATA:PATT #H3F,8

<subsystem>:NAVigation:SIMulation:TBASis <SystemTime>

Determines the time basis used to enter the simulation start time. Per default, the UTC (Universal Time Coordinates) is used but the user may choose or switch to a different time basis at any time. The time is then automatically recalculated and displayed in the selected time format.

Parameters:

<SystemTime> UTC | GPS | GST | GLO
*RST: UTC

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

<subsystem>:NAVigation:SIMulation:DATE <Year>, <Month>, <Day>

Defines the date for the simulation in DD.MM.YYYY format of the Gregorian calendar.

This setting is only available for <subsystem>:NAVigation:DATA set to RNDData and <subsystem>:NAVigation:SIMulation:TBASis set to UTC.

Parameters:

<Year> integer
Range: 1980 to 9999
Increment: 1

<Month> integer
Range: 1 to 12
Increment: 1

<Day> integer
Range: 1 to 31
Increment: 1

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

<subsystem>:NAVigation:SIMulation:TIME <Hour>, <Minute>, <Second>

Defines the exact simulation start time in UTC time format. For details see "[Time \[hh:mm:ss:xxx\]](#)" on page 47.

This setting is only available for <subsystem>:NAVigation:DATA set to RNDData and <subsystem>:NAVigation:SIMulation:TBASis set to UTC.

Parameters:

<Hour> integer
Range: 0 to 23
Increment: 1

<Minute> integer
 Range: 0 to 59
 Increment: 1

<Second> float
 Range: 0 to 59.999
 Increment: 0.001

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

<subsystem>:NAVigation:SIMulation:WNUMber <Week>

Enters the week number (WN) the navigation signal is generated for. For details see ["Week Number"](#) on page 47.

This setting is only available for `<subsystem>:NAVigation:SIMulation:TBASis` set to GPS or GST and `<subsystem>:NAVigation:DATA` set to RNDatA.

Parameters:

<Week> integer
 The weeks are numbered starting from a reference point of time (WN_REF=0), that depends on the navigation standard.
 Range: 0 to 9999.0*53
 Increment: 1
 *RST: 0

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

<subsystem>:NAVigation:SIMulation:TOWeek <TOW>

Defines the simulation start time within the defined week (see `<subsystem>:NAVigation:SIMulation:WNUMber`).

This setting is only available for `<subsystem>:NAVigation:SIMulation:TBASis` set to GPS or GST.

Parameters:

<TOW> float
 number of seconds since the beginning of the week
 Range: 0 to 604799.999
 Increment: 0.001
 *RST: 0

Example: See [example "Selecting Real Navigation Data"](#) on page 123.

4.4 Hybrid GNSS Configuration

<code><subsystem>:HYBRid:<GNSS>[:STATe]</code>	127
<code><subsystem>:HYBRid:GALileo[:STATe]</code>	127

<subsystem>:HYBRid:GLONass[:STATe].....	127
<subsystem>:HYBRid:GPS[:STATe].....	127
<subsystem>:UCRF.....	127
<subsystem>:UMGPS.....	127

<subsystem>:HYBRid:<GNSS>[:STATe]
<subsystem>:HYBRid:GALileo[:STATe] <State>
<subsystem>:HYBRid:GLONass[:STATe]
<subsystem>:HYBRid:GPS[:STATe] <State>

Defines the navigation standards that will be part of the hybrid configuration. Only the satellites of an enabled standard are configurable (see [chapter 4.8, "Satellites Configuration and Satellites Signal Settings"](#), on page 142).

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 0

<subsystem>:UCRF <use_central_RF>

Use this command if several R&S SMBV instruments are connected to generate GNSS signal in the same GNSS band.

Parameters:

<use_central_RF> 0 | 1 | OFF | ON
 *RST: 0

<subsystem>:UMGPS <use_military>

Enables the configuration of GPS signals modulates with P code, see [<subsystem>:SATellite<st>:SIGNal](#).

Parameters:

<use_military> 0 | 1 | OFF | ON
 *RST: 0

Options: R&S SMBV-K93

4.5 Almanac/RINEX Configuration

The following examples use GPS entry standard. It is assumed, that a RF Band common for the GNSS standards is selected.

Example: Selecting an Almanac file

SCPI Command	Response
BB:GPS:HYBR:GAL:STAT ON	
BB:GPS:NAV:ALM:GPS:FILE 'GPS_SEM585.txt'	
BB:GPS:NAV:ALM:GAL:FILE 'GAL_Yuma585.txt'	
BB:GPS:NAV:ALM:GLON:FILE 'GLO_585.ag1'	
BB:GPS:SVID:GPS:LIST?	2,3,4,5,6,7,8,9,10, 11,12,13,14,15,16,17, 18,19,20,21,22,23,24, 25,26,27,28,29,30,31, 32
BB:GPS:SVID:GAL:LIST?	1,2,3,4,5,6,7,8,9,10, 11,12,13,14,15,16,17, 18,19,20,21,22,23,24, 25,26,27,28,29,30
BB:GPS:SVID:GAL:LIST?	1,2,5,8,9,10,11,12, 13,15,16,17,18,19,20, 21,22,23,24



Some commands of the following description do not apply to the new functionality for Glonass satellites. If so, it is explicitly pointed out. In these cases, you can substitute the wildcard <GNSS> either with GPS or GALileo, but not for GLONass.

Example: Configuring a RINEX file

```
BB:GPS:NAV:RIN:GPS:FILE
'<root>/Lists/GNSS/GPS/Rinex/GPS_Week585_Day0.10n'
BB:GPS:NAV:RIN:IMP
BB:GPS:NAV:RIN:UUAS
BB:GPS:NAV:RIN:GPS:STAT ON
```

<subsystem>:NAVigation:ALManac:<GNSS>:DATE:BEGIN.....	129
<subsystem>:NAVigation:ALManac:GALileo:DATE:BEGIN.....	129
<subsystem>:NAVigation:ALManac:GPS:DATE:BEGIN.....	129
<subsystem>:NAVigation:ALManac:<GNSS>:DATE:END.....	130
<subsystem>:NAVigation:ALManac:GALileo:DATE:END.....	130
<subsystem>:NAVigation:ALManac:GPS:DATE:END.....	130
<subsystem>:NAVigation:ALManac:<GNSS>:FILE.....	130
<subsystem>:NAVigation:ALManac:GALileo:FILE.....	130
<subsystem>:NAVigation:ALManac:GLONass:FILE.....	130
<subsystem>:NAVigation:ALManac:GPS:FILE.....	130
<subsystem>:NAVigation:ALManac:GLONass:TOApplicability:DATE.....	130
<subsystem>:NAVigation:ALManac:GLONass:TOApplicability:TIME.....	131
<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:TOWeek.....	132
<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:TOWeek.....	132
<subsystem>:NAVigation:ALManac:GPS:TOApplicability:TOWeek.....	132
<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:WNUMBER.....	132

<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:WNUmber.....	132
<subsystem>:NAVigation:ALManac:GPS:TOApplicability:WNUmber.....	132
<subsystem>:NAVigation:ALManac:<GNSS>:WNUmber.....	132
<subsystem>:NAVigation:ALManac:GALileo:WNUmber.....	132
<subsystem>:NAVigation:ALManac:GPS:WNUmber.....	132
<subsystem>:NAVigation:RINex:<GNSS>:FILE.....	133
<subsystem>:NAVigation:RINex:GALileo:FILE.....	133
<subsystem>:NAVigation:RINex:GLONass:FILE.....	133
<subsystem>:NAVigation:RINex:GPS:FILE.....	133
<subsystem>:NAVigation:RINex:<GNSS>:STATe.....	133
<subsystem>:NAVigation:RINex:GALileo:STATe.....	133
<subsystem>:NAVigation:RINex:GLONass:STATe.....	133
<subsystem>:NAVigation:RINex:GPS:STATe.....	133
<subsystem>:NAVigation:RINex:IMPort.....	133
<subsystem>:NAVigation:RINex:UUAState.....	133
<subsystem>:NAVigation:RINex:UFNState.....	134
<subsystem>:SVID:<GNSS>:LIST.....	134
<subsystem>:SVID:GALileo:LIST.....	134
<subsystem>:SVID:GPS:LIST.....	134

<subsystem>:NAVigation:ALManac:<GNSS>:DATE:BEgIn

<subsystem>:NAVigation:ALManac:GALileo:DATE:BEgIn?

<subsystem>:NAVigation:ALManac:GPS:DATE:BEgIn?

This setting is only available for GPS and Galileo satellites.

Queries the start date of the week span of the selected almanac file for the navigation standard. The file is selected using `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

Return values:

<Year>	integer
	Range: 1980 to 9999
	Increment: 1
<Month>	integer
	Range: 1 to 12
	Increment: 1
<Day>	integer
	Range: 1 to 31
	Increment: 1

Example: BB:GPS:NAV:ALM:GAL:DATE:BEg?
Response: 2010,11,07

Usage: Query only

```
<subsystem>:NAVigation:ALManac:<GNSS>:DATE:END
<subsystem>:NAVigation:ALManac:GALileo:DATE:END?
<subsystem>:NAVigation:ALManac:GPS:DATE:END?
```

This setting is only available for GPS and Galileo satellites.

Queries the end date of the week span of the selected almanac file for the navigation standard. The file is selected using `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

Return values:

```
<Year>                integer
                        Range:    1980 to 9999
                        Increment: 1

<Month>               integer
                        Range:    1 to 12
                        Increment: 1

<Day>                 integer
                        Range:    1 to 31
                        Increment: 1
```

Example: BB:GPS:NAV:ALM:GAL:DATE:END?
Response: 2010, 11, 14

Usage: Query only

```
<subsystem>:NAVigation:ALManac:<GNSS>:FILE
<subsystem>:NAVigation:ALManac:GALileo:FILE <Almanac>
<subsystem>:NAVigation:ALManac:GLONass:FILE
<subsystem>:NAVigation:ALManac:GPS:FILE <Almanac>
```

Defines the almanac file for the navigation standard. For details see "[Almanac Configuration](#)" on page 50.

Parameters:

```
<Almanac>             string
```

Example: See [example "Selecting an Almanac file"](#) on page 128.

```
<subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:DATE?
```

Queries the date of applicability of the selected almanac file for the navigation standard.

Note: This setting is available for Glonass. It is no longer supported for GPS and Galileo satellites. To get the applicability data of GPS and Galileo satellites, refer to the commands `<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:TOWeek` on page 132 and `<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:WNUMber` on page 132.

Return values:

<Year>	integer
	Range: 1996 to 9999
	Increment: 1
<Month>	integer
	Range: 1 to 12
	Increment: 1
<Day>	integer
	Range: 1 to 31
	Increment: 1

Example:

BB:GPS:NAV:ALM:GLON:TOAP:DATE?
Response: 2010,11,07

Usage:

Query only

<subsystem>:NAVigation:ALManac:GLONass:TOAPplicability:TIME?

Queries the start time of applicability of the selected almanac file for the navigation standard.

Note: This setting is available for Glonass. It is no longer supported for GPS and Galileo satellites. To get the applicability data of GPS and Galileo satellites, refer to the commands [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:TOWeek](#) on page 132 and [<subsystem>:NAVigation:ALManac:<GNSS>:TOAPplicability:WNUMBER](#) on page 132.

Return values:

<Hour>	integer
	Range: 0 to 23
	Increment: 1
<Minute>	integer
	Range: 0 to 59
	Increment: 1
<Second>	float
	Range: 0 to 59.999
	Increment: 0.001

Example:

BB:GPS:NAV:ALM:GLON:TOAP:TIME?
Response: 17,0,0

Usage:

Query only

<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:TOWeek
<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:TOWeek?
<subsystem>:NAVigation:ALManac:GPS:TOApplicability:TOWeek?

Determines the Time of Week (TOW) the selected almanac is used for (time of applicability).

Return values:

<Tow> float
 Range: 0 to 604799.999
 Increment: 0.001
 *RST: 0

Usage: Query only

<subsystem>:NAVigation:ALManac:<GNSS>:TOApplicability:WNUmber
<subsystem>:NAVigation:ALManac:GALileo:TOApplicability:WNUmber?
<subsystem>:NAVigation:ALManac:GPS:TOApplicability:WNUmber?

This setting is only available for Galileo and GPS satellites.

Determines the Week Number for which the selected almanac is used for (time of applicability).

Return values:

<WN> integer
 Range: 0 to 9999.0*53
 Increment: 1
 *RST: 1488

Usage: Query only

<subsystem>:NAVigation:ALManac:<GNSS>:WNUmber
<subsystem>:NAVigation:ALManac:GALileo:WNUmber?
<subsystem>:NAVigation:ALManac:GPS:WNUmber?

This setting is only available for GPS and Galileo satellites.

Queries the week number of the selected almanac file for the navigation standard. The file is selected using `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

Return values:

<WeekNumber> integer
 Range: 0 to 529947
 *RST: 1488

Example: BB:GPS:NAV:ALM:GPS:WNUM?
 Response: 585

Usage: Query only

```

<subsystem>:NAVigation:RINex:<GNSS>:FILE
<subsystem>:NAVigation:RINex:GALileo:FILE <Filename>
<subsystem>:NAVigation:RINex:GLONass:FILE
<subsystem>:NAVigation:RINex:GPS:FILE <Filename>

```

Selects and activates one RINEX file per navigation standard. Perform `<subsystem>:NAVigation:RINex:IMPort` to upload the selected file.

For details see ["RINEX Configuration"](#) on page 51.

Parameters:

<Filename> string

Example: See [example "Configuring a RINEX file"](#) on page 128.

```

<subsystem>:NAVigation:RINex:<GNSS>:STATe
<subsystem>:NAVigation:RINex:GALileo:STATe <State>
<subsystem>:NAVigation:RINex:GLONass:STATe
<subsystem>:NAVigation:RINex:GPS:STATe <State>

```

Activates a RINEX configuration file previously selected (see `<subsystem>:NAVigation:RINex:GPS:FILE`) and imported (see `<subsystem>:NAVigation:RINex:IMPort`).

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See [example "Configuring a RINEX file"](#) on page 128.

```

<subsystem>:NAVigation:RINex:IMPort

```

Uploads the RINEX file selected by `<subsystem>:NAVigation:RINex:GPS:FILE`.

Example: See [example "Configuring a RINEX file"](#) on page 128.

Usage: Event

```

<subsystem>:NAVigation:RINex:UUAState <State>

```

Synchronizes the time conversion and the atmospheric parameters to the corresponding values retrieved from the RINEX file.

Parameters:

<State> 0 | 1 | OFF | ON

*RST: 0

Example: See [example "Configuring a RINEX file"](#) on page 128.

<subsystem>:NAVigation:RINex:UFNState <State>

Updates the frequency number for Glonass satellites automatically at import of a RINEX File.

Parameters:

<State> 0 | 1 | OFF | ON
*RST: 0

Example: BB:GPS:NAV:RIN:UFNS 1

<subsystem>:SVID:<GNSS>:LIST**<subsystem>:SVID:GALileo:LIST?****<subsystem>:SVID:GPS:LIST?**

Queries the list of valid satellites (SV IDs) of the selected almanac file for the navigation standard. The file is selected using `<subsystem>:NAVigation:ALManac:<GNSS>:FILE`.

Example: See [example "Selecting an Almanac file"](#) on page 128.

Usage: Query only

4.6 Time Conversion Configuration

The following example uses GPS entry standard.

Example: Configuring the time conversion and leap seconds settings

SCPI Command	Response
BB:GPS:PRES	
BB:GPS:SMOD USER	
BB:GPS:NAV:TCON:GPS:AZER?	0
BB:GPS:NAV:TCON:GPS:AONE?	0
BB:GPS:NAV:TCON:GPS:TOT?	0
BB:GPS:NAV:TCON:GPS:WONT?	0
BB:GPS:NAV:TCON:LEAP:SYNC	
BB:GPS:NAV:TCON:LEAP:SLST:STAT ON	
BB:GPS:NAV:TCON:LEAP:SEC?	15
BB:GPS:NAV:TCON:LEAP:DATE?	2010,11,8
BB:GPS:NAV:TCON:LEAP:SIGN?	PLUS

<subsystem>:NAVigation:TCONversion:<GNSS>:AONE	135
<subsystem>:NAVigation:TCONversion:GALileo:AONE	135
<subsystem>:NAVigation:TCONversion:GPS:AONE	135

<subsystem>:NAVigation:TCONversion:<GNSS>:AZERo.....	135
<subsystem>:NAVigation:TCONversion:GALileo:AZERo.....	135
<subsystem>:NAVigation:TCONversion:GPS:AZERo.....	135
<subsystem>:NAVigation:TCONversion:<GNSS>:TOT.....	136
<subsystem>:NAVigation:TCONversion:GALileo:TOT.....	136
<subsystem>:NAVigation:TCONversion:GPS:TOT.....	136
<subsystem>:NAVigation:TCONversion:<GNSS>:WNOT.....	136
<subsystem>:NAVigation:TCONversion:GALileo:WNOT.....	136
<subsystem>:NAVigation:TCONversion:GPS:WNOT.....	136
<subsystem>:NAVigation:TCONversion:UTCSu:AONE.....	136
<subsystem>:NAVigation:TCONversion:UTCSu:AZERo.....	137
<subsystem>:NAVigation:TCONversion:UTCSu:DATE.....	137
<subsystem>:NAVigation:TCONversion:LEAP:SLSTransition[:STATE].....	137
<subsystem>:NAVigation:TCONversion:LEAP:DATE.....	137
<subsystem>:NAVigation:TCONversion:LEAP:SEConds.....	138
<subsystem>:NAVigation:TCONversion:LEAP:SIGN.....	138
<subsystem>:NAVigation:TCONversion:LEAP:SYNC.....	138

<subsystem>:NAVigation:TCONversion:<GNSS>:AONE**<subsystem>:NAVigation:TCONversion:GALileo:AONE <AOne>****<subsystem>:NAVigation:TCONversion:GPS:AONE <AOne>**

Defines the 1st order term of polynomial, A_1 .

This setting is only available for <subsystem>:SMODE STATIC or USER.

For details see [chapter 3.3, "Time Conversion Configuration"](#), on page 51.

Parameters:

<AOne> integer
 Range: -8388608 to 8388607
 Increment: 1
 *RST: 0

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

<subsystem>:NAVigation:TCONversion:<GNSS>:AZERo**<subsystem>:NAVigation:TCONversion:GALileo:AZERo <AZero>****<subsystem>:NAVigation:TCONversion:GPS:AZERo <AZero>**

Defines the constant term of polynomial, A_0 .

This setting is only available for <subsystem>:SMODE STATIC or USER.

For details see [chapter 3.3, "Time Conversion Configuration"](#), on page 51.

Parameters:

<AZero> integer
 Range: -2147483648 to 2147483647
 Increment: 1
 *RST: 0

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

```
<subsystem>:NAVigation:TCOnversion:<GNSS>:TOT
<subsystem>:NAVigation:TCOnversion:GALileo:TOT <Tot>
<subsystem>:NAVigation:TCOnversion:GPS:TOT <Tot>
```

Defines the UTC data reference time of week, t_{ot} .

This setting is only available for `<subsystem>:SMODE` `STATIC` or `USER`.

For details see [chapter 3.3, "Time Conversion Configuration"](#), on page 51.

Parameters:

```
<Tot>                integer
                    Range:    0 to 255
                    Increment: 1
                    *RST:    0
```

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

```
<subsystem>:NAVigation:TCOnversion:<GNSS>:WNOT
<subsystem>:NAVigation:TCOnversion:GALileo:WNOT <Wnot>
<subsystem>:NAVigation:TCOnversion:GPS:WNOT <Wnot>
```

Defines the UTC data reference week number, WN_i .

This setting is only available for `<subsystem>:SMODE` `STATIC` or `USER`.

For details see [chapter 3.3, "Time Conversion Configuration"](#), on page 51.

Parameters:

```
<Wnot>               integer
                    Range:    0 to 255
                    Increment: 1
                    *RST:    0
```

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

```
<subsystem>:NAVigation:TCOnversion:UTCSu:AONE <A_1>
```

Defines the 1st order term of polynomial, A_1 .

Parameters:

```
<A_1>                integer
                    Range:    -512 to 511
                    Increment: 1
                    *RST:    0
```

Options: R&S SMx/AMU-K294

R&S SMBV-K94

<subsystem>:NAVigation:TCONversion:UTCSu:AZERo <A_0>

Defines the constant term of polynomial, A_0 .

Parameters:

<A_0> integer
 Range: -1024 to 1023
 Increment: 1
 *RST: 0

Options: R&S SMx/AMU-K294
 R&S SMBV-K94

<subsystem>:NAVigation:TCONversion:UTCSu:DATE?

Enters the date for the UTC-UTC(SU) data in DMS format.

Return values:

<Year> integer
 Range: 1996 to 9999
 Increment: 1

<Month> integer
 Range: 1 to 12
 Increment: 1

<Day> integer
 Range: 1 to 31
 Increment: 1

Usage: Query only

Options: R&S SMx/AMU-K294
 R&S SMBV-K94

<subsystem>:NAVigation:TCONversion:LEAP:SLSTransition[:STATe] <State>

Enables/disables the simulation of the leap second transition.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: Off

<subsystem>:NAVigation:TCONversion:LEAP:DATE <Year>, <Month>, <Day>

Defines the date of the next UTC time correction.

For details see "[Leap Second Configuration](#)" on page 53.

Parameters:

<Year>	integer
	Range: 1980 to 9999
	Increment: 1
<Month>	integer
	Range: 1 to 12
	Increment: 1
<Day>	integer
	Range: 1 to 31
	Increment: 1

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

Options: R&S SMBV-K92

<subsystem>:NAVigation:TCONversion:LEAP:SECONDS <Seconds>

Defines the currently used leap second. For details see "[Leap Second Configuration](#)" on page 53.

Parameters:

<Seconds>	float
	Range: 0 to 50
	Increment: 1
	*RST: 15

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

<subsystem>:NAVigation:TCONversion:LEAP:SIGN <Sign>

Defines whether one second is added to or subtracted from the current leap second value during synchronization. For details see "[Leap Second Configuration](#)" on page 53.

Parameters:

<Sign>	PLUS MINus
	*RST: PLUS

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

Options: R&S SMBV-K92

<subsystem>:NAVigation:TCONversion:LEAP:SYNC

Synchronizes the leap second according to the simulation time. For details see "[Leap Second Configuration](#)" on page 53.

Example: See [example "Configuring the time conversion and leap seconds settings"](#) on page 134.

Usage: Event

4.7 Multipath Configuration



The multipath settings are enabled for instrument equipped with option GNSS Enhanced (R&S SMBV-K92).

Suffixes

The suffix index **SVID<ch>** distinguishes between the SV IDs

Value range: 1 .. 37 for GPS satellites and 1 .. 50 for Galileo satellite; the SV ID must correspond to a healthy satellite!

The suffix index **TAP<us>** distinguishes between the taps in the multipath configuration.

Value range: 1 .. 10

Examples

The following example uses GPS entry standard.

Example: Configuring the multipath settings for SV ID#20

SCPI Command	Response
BB:GPS:PRES	
BB:GPS:SMOD USER	
BB:GPS:SAT:COUN?	8
BB:GPS:SAT2:SVID?	20
BB:GPS:SAT2:STAN?	GAL
BB:GPS:SVID20:GAL:MPAT:TAP:COUN 2	
BB:GPS:SVID20:GAL:MPAT:TAP1:POW -3	
BB:GPS:SVID20:GAL:MPAT:TAP1:DSH 100	
BB:GPS:SVID20:GAL:MPAT:TAP1:CPH 3.14	
BB:GPS:SVID20:GAL:MPAT:TAP2:TSH 1	
BB:GPS:SVID20:GAL:MPAT:TAP2:POW -5	
BB:GPS:SVID20:GAL:MPAT:STAT ON	
<subsystem>:SVID<ch>:<GNSS>:MPATH:STATe	140
<subsystem>:SVID<ch>:GALileo:MPATH:STATe	140
<subsystem>:SVID<ch>:GPS:MPATH:STATe	140

<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT.....	140
<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT.....	140
<subsystem>:SVID<ch>:GPS:MPATH:TAP:COUNT.....	140
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase.....	141
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:CPHase.....	141
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:CPHase.....	141
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift.....	141
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:DSHift.....	141
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:DSHift.....	141
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWer.....	141
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:POWer.....	141
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:POWer.....	141
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:POWer.....	141
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TSHift.....	142
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:TSHift.....	142
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:TSHift.....	142

<subsystem>:SVID<ch>:<GNSS>:MPATH:STATE

<subsystem>:SVID<ch>:GALileo:MPATH:STATE <State>

<subsystem>:SVID<ch>:GPS:MPATH:STATE <State>

Enables/disables the generation of multipath signals for the satellite with the specified SV ID belonging to the specified GNSS standard. Settings made with the subsequent <subsystem>:SVID<ch>:<GNSS>:MPATH commands are considered only if the multipath configuration is enabled.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 0

Example: See [example "Configuring the multipath settings for SV ID#20"](#) on page 139.

Options: R&S SMBV-K92

<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP:COUNT

<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT <Taps>

<subsystem>:SVID<ch>:GPS:MPATH:TAP:COUNT <Taps>

Sets the paths number. The value determines the number of rows available for configuration.

For details see ["Number of Taps"](#) on page 88.

Parameters:

<Taps> float
 Range: 1 to 10
 Increment: 1
 *RST: 1

Example: See [example "Configuring the multipath settings for SV ID#20"](#) on page 139.

Options: R&S SMBV-K92

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:CPHase
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:CPHase <Phase>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:CPHase <Phase>
```

Sets the carrier phase, used in case of multipath simulation.

Parameters:

```
<Phase> float
Range: 0 to 6.28
Increment: 0.01
*RST: 0
Default unit: rad
```

Example: See [example "Configuring the multipath settings for SV ID#20"](#) on page 139.

Options: R&S SMBV-K92

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:DSHift
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:DSHift <DopplerShift>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:DSHift <DopplerShift>
```

Defines the additional Doppler shift of the simulated signal of the satellite, used to simulate multipath conditions.

Parameters:

```
<DopplerShift> float
Range: -10.0E3 to 10.0E3
Increment: 0.01
*RST: 0
Default unit: Hz
```

Example: See [example "Configuring the multipath settings for SV ID#20"](#) on page 139.

Options: R&S SMBV-K92

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:POWer
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:POWer <Power>
<subsystem>:SVID<ch>:GLONass:MPATH:TAP<us>:POWer <Power>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:POWer <Power>
```

Sets the additional power of the satellite in dB, used to simulate multipath conditions.

See [chapter 3.4.1, "Power Configuration"](#), on page 55 for information about the power calculation.

Parameters:

<Power> float
 Range: -10 to 0
 Increment: 0.01
 *RST: 0
 Default unit: dB

Example:

See [example "Configuring the multipath settings for SV ID#20"](#) on page 139 and [example "Configuring the power settings"](#) on page 152.

Options:

R&S SMBV-K92

```
<subsystem>:SVID<ch>:<GNSS>:MPATH:TAP<us>:TShift
<subsystem>:SVID<ch>:GALileo:MPATH:TAP<us>:TShift <TimeShift>
<subsystem>:SVID<ch>:GPS:MPATH:TAP<us>:TShift <TimeShift>
```

Sets an additional delay of the selected satellite, used to simulate multipath conditions.

Parameters:

<TimeShift> float
 Range: 0 to 9.99999
 Increment: 0.00001
 *RST: 0
 Default unit: Chips

Example:

See [example "Configuring the multipath settings for SV ID#20"](#) on page 139.

Options:

R&S SMBV-K92

4.8 Satellites Configuration and Satellites Signal Settings

Suffixes

The suffix index `Satellite<st>` distinguishes between the satellites.

Value range: 1 .. 24; configurations with more than 6 satellites require option R&S SMBV-K91, more than 12 satellites require option R&S SMBV-K96.

Examples

The following example uses GPS entry standard.

Example: Configuring the satellite's constellation

SCPI Command	Response
BB:GPS:PRES	
BB:GPS:SMOD USER	

Satellites Configuration and Satellites Signal Settings

SCPI Command	Response
BB:GPS:SEM 7.5	
BB:GPS:SAT:COUN 8	
BB:GPS:GOC	
BB:GPS:SAT:GRTP ON	
BB:GPS:SAT1:STAN?	GPS
BB:GPS:SAT1:SIGN?	CAC
BB:GPS:SAT1:SVID?	19
BB:GPS:SAT1:SCR?	1023000
BB:GPS:SAT1:MOD?	BPSK
BB:GPS:SAT1:DUR?	10833
BB:GPS:SAT1:PRAN?	20719113.866605
BB:GPS:SAT1:PRB 0	
BB:GPS:SAT1:TSH?	70701.0897703667
BB:GPS:SAT1:DSH?	349.357758269347
BB:GPS:SAT1:ICPH?	0
BB:GPS:SAT1:FREQ?	1575420349.35776
BB:GPS:SAT1:CACR?	1023000.22685564
BB:GPS:SVID19:GPS:MPAT:STAT?	0
BB:GPS:SAT1:STAT ON	
BB:GPS:STAT ON	
BB:GPS:HDOP?	1.30620600795132
BB:GPS:PDOP?	2.65785384283367
<subsystem>:SPReading[:STATe].....	144
<subsystem>:SEMAsk.....	144
<subsystem>:HDOP.....	144
<subsystem>:PDOP.....	145
<subsystem>:GALModulation.....	145
<subsystem>:GOConstellation.....	145
<subsystem>:SATellite:GRTPProjection.....	146
<subsystem>:SATellite:COUNT.....	146
<subsystem>:SATellite<st>:CACRate.....	146
<subsystem>:SATellite<st>:DSHift.....	147
<subsystem>:SATellite<st>:DURation.....	147
<subsystem>:SATellite<st>:FNUMber.....	147
<subsystem>:SATellite<st>:FREQuency.....	147
<subsystem>:SATellite<st>:CPHase.....	148
<subsystem>:SATellite<st>:ICPHase.....	148
<subsystem>:SATellite<st>:PCRRate.....	148

<code><subsystem>:SATellite<st>:MODulation</code>	148
<code><subsystem>:SATellite<st>:PRANge</code>	149
<code><subsystem>:SATellite<st>:PRBias</code>	149
<code><subsystem>:SATellite<st>:SCRate</code>	149
<code><subsystem>:SATellite<st>:SIGNal</code>	150
<code><subsystem>:SATellite<st>:STANdard</code>	150
<code><subsystem>:SATellite<st>:STATe</code>	150
<code><subsystem>:SATellite<st>:SVID</code>	150
<code><subsystem>:SATellite<st>:TSHift</code>	151

`<subsystem>:SPReading[:STATe] <State>`

Activates/deactivates spreading. When spreading is deactivated the pure navigation data is modulated onto the RF carrier.

This setting is only available for `<subsystem>:SMODE STATic`.

Parameters:

`<State>` 0 | 1 | OFF | ON
 *RST: 1

Example:

```
BB:GPS:SMOD STAT
BB:GPS:SPR:STAT ON
```

`<subsystem>:SEMAsk <SEMAsk>`

Sets the satellite's elevation mask, i.e. determines the elevation filter applied when `<subsystem>:GOConstellation` is performed, or, while using the Auto Localization mode, the filter used to filter all low-elevation satellites which are closer to the horizon and may witness in reality more unwanted multipath effects.

For details see "Elevation Mask" on page 62.

This setting is only available for `<subsystem>:SMODE AUTO or USER`.

Parameters:

`<SEMAsk>` float
 Range: 2.5 to 10.0
 *RST: 5

Example:

See [example "Configuring the satellite's constellation"](#) on page 142.

`<subsystem>:HDOP?`

Queries the HDOP (Horizontal Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

At least four different satellites have to be configured to get a reasonable value; otherwise -1 will be returned.

For details see "Initial HDOP/PDOP" on page 62.

This setting is only available for `<subsystem>:SMODE` AUTO or USER.

Return values:

`<Hdop>` float
Increment: 0.01

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

`<subsystem>:PDOP?`

Displays the PDOP (Position Dilution of Precision) of the selected satellite constellation at the beginning of the simulation.

At least four different satellites have to be configured to get a reasonable value; otherwise -1 will be returned.

For details see ["Initial HDOP/PDOP"](#) on page 62.

This setting is only available for `<subsystem>:SMODE` AUTO or USER.

Return values:

`<PDop>` float
Increment: 0.01
*RST: 0

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

`<subsystem>:GALModulation <Modulation>`

Defines the modulation mode used for modulating the galileo carrier signal.

BOC(1,1) modulation can be set with Galileo instead of CBOC(6,1) to reduce the sample rate required to simulate a certain period of time.

Parameters:

`<Modulation>` BOC | CBOC
*RST: CBOC

`<subsystem>:GOConstellation`

Retrieves an optimal satellite constellation for the selected Almanac/RINEX file, elevation mask and the enabled maximum number of satellites.

Usage: Event

<subsystem>:SATellite:GRTProjection <glb_RT_proj>

Forces ephemeris projection for all satellites, i.e. performs the same action as the command `<subsystem>:SVID<ch>:<GNSS>:NMEssage:RTPRojection`.

Parameters:

`<glb_RT_proj>` 0 | 1 | OFF | ON
 *RST: 0

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite:COUNT <SatCount>

Defines the maximum number of satellites that can be simulated. The minimum allowed number depends on the selected simulation mode (see `<subsystem>:SMODE` on page 115).

Configurations with one satellite are allowed only for `<subsystem>:SMODE` `STATIC`. For `<subsystem>:SMODE` `AUTO` or `USER`, four satellites or more are required.

Note: Generating the navigation signal with more than 6 satellites is enabled only for instruments equipped with option R&S SMBV-K91; more than 12 satellites require option R&S SMBV-K96.

The number of satellites determines the value range of the suffix for `<subsystem>:SATellite<st>` commands.

Parameters:

`<SatCount>` integer
 Range: 1 to 24
 Increment: 1
 *RST: 1

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:CACRate?

Queries the currently valid values for the chip rate.

For details see ["Resulting Start Chip Rate"](#) on page 70.

Return values:

`<CACRate>` float
 Default unit: Hz

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

<subsystem>:SATellite<st>:DSHift <DopplerShift>

Defines the Doppler shift of the simulated signal of the satellite.

For details see ["Doppler Shift"](#) on page 69.

Parameters:

<DopplerShift> float
Range: -100.0e3 to 100.0e3
Increment: 0.01
*RST: 0
Default unit: Hz

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:DURation?

Displays the time the satellite's elevation is higher than 2.5, 5, 7.5 or 10° starting at the first simulation moment of the satellite of interest, as selected with the command

[<subsystem>:SEMAsk](#).

For details see ["Duration \(Elev. > 2.5/5/7.5/10°\)"](#) on page 68.

Return values:

<Duration> float
Default unit: s

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

<subsystem>:SATellite<st>:FNUMBER <FrequencyNumber>

The command sets or queries the frequency number, depending on the used data source. The parameter corresponds to the sub-carrier used to modulate the GLONASS satellite.

Parameters:

<FrequencyNumber> integer
Range: -7 to 24
Increment: 1
*RST: 0

<subsystem>:SATellite<st>:FREQuency?

Queries the currently valid values for Doppler-shifted carrier frequency.

For details see ["Resulting Start Frequency"](#) on page 69.

Return values:

<Frequency> float
 Default unit: Hz

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

<subsystem>:SATellite<st>:CPHase <code>

Sets the initial code phase in chips while working in static simulation mode and using arbitrary navigation data source.

Parameters:

<code> float
 Range: 0 to 20459.99
 Increment: 0.01
 *RST: 0

<subsystem>:SATellite<st>:ICPhase <ICPhase>

Sets the initial carrier phase.

This setting is only available for `<subsystem>:SMODE STATIC`. The parameter is updated automatically for `USER` and `AUTO`.

Parameters:

<ICPhase> float
 Range: 0 to 6.28
 Increment: 0.01
 *RST: 0

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:PCRate?

Queries the currently valid values for the chip rate of the P-code.

Return values:

<PCRate> float

Usage: Query only

Options: R&S SMBV-K93

<subsystem>:SATellite<st>:MODulation <Modulation>

Defines the modulation used for modulating the carrier signal.

Parameters:

<Modulation> BPSK | CBOC
 *RST: BPSK

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:PRANge <Pseudorange>

Defines the propagation delay from satellite to receiver in meters.

This setting is only available for <subsystem>:SMODE STATIC.

For details see ["Pseudorange"](#) on page 68.

Parameters:

<Pseudorange> float
 Range: 0 to (2.499E6)/1.023E6*SPEED_OF_LIGHT
 Increment: 0.001
 *RST: 0
 Default unit: m

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:PRBias <PseudorangeBias>

Sets a bias to the pseudorange of a satellite (see also <subsystem>:SATellite<st>:PRANge on page 149).

This setting is only available for <subsystem>:SMODE AUTO or USER.

Parameters:

<PseudorangeBias> float
 Range: -1000 to 1000
 Increment: 0.001
 *RST: 0
 Default unit: m

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:SCRate?

Queries the standard chip rate.

Return values:

<ChipRate> float
 Default unit: Hz

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

Usage: Query only

<subsystem>:SATellite<st>:SIGNal <Signal>

Selects the type of signal the corresponding satellite is using.

For details and an overview of supported signals see ["Signal\(s\)"](#) on page 65.

Enabled `<subsystem>:UMGPS` is prerequisites for using P codes.

Parameters:

<Signal> CACode | PCODE | CAPQ | CAPI | E1Def | RCA
 *RST: CACode

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:STANdard <Standard>

Selects the navigation standard the corresponding satellite belongs to. The available GNSS standards depend on the selected Hybrid GNSS configuration (see [chapter 4.5, "Almanac/RINEX Configuration"](#), on page 127) and the installed options.

Parameters:

<Standard> GPS | GALileo
 *RST: GPS

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:STATe <State>

Activates/deactivates the satellite.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 0

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:SVID <Svid>

Defines the Space Vehicle ID of the satellite to be simulated. This value is used to generate the corresponding spreading code.

For `<subsystem>:NAVigation:DATA RNData`, only the valid IDs which are listed in the almanac are selectable; for arbitrary data, any ID can be selected.

SV ID set to -1 corresponds to the manual selection "N.A. (not assigned)". It is not allowed to assign the same SV ID to more than one satellite of one GNSS standard. Hence, the selection N.A. can be used to exchange the assigned SV ID to different satellites belonging to the same standard.

Parameters:

<Svid> integer
 Range: 1 to 40
 Increment: 1
 *RST: 1

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

<subsystem>:SATellite<st>:TSHift <TimeShift>

Defines the propagation delay from satellite to receiver.

For details see ["Time Shift/ chips"](#) on page 69.

Parameters:

<TimeShift> float
 time shift in chips
 Range: 0 to 2499999.999
 Increment: 0.001
 *RST: 0

Example: See [example "Configuring the satellite's constellation"](#) on page 142.

4.9 Global Signal Configuration

<subsystem>:SVID:SIGNAl:COUPling <State>

For quick configuration, enables the configuration of all SV IDs simultaneously, i.e. the value set for the first available SV ID is used for all other. Current settings are overwritten.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 1

<subsystem>:SVID<ch>:<GNSS>:SIGNAl

<subsystem>:SVID<ch>:GPS:SIGNAl <Signal>

For quick configuration, enables the configuration of all SV IDs simultaneously, i.e. the value set for the first available SV ID is used for all other. Current settings are overwritten.

Parameters:

<Signal> CACode | PCODE | CAPQ | CAPI
 *RST: CACode

Options: R&S SMBV-K93

4.10 Power Tuning and Power Settings

The following example uses GPS entry standard.

Example: Configuring the power settings

SCPI Command	Response
BB:GPS:PRES	
BB:GPS:SMOD USER	
BB:GPS:HYBR:GAL:STAT ON	
BB:GPS:SAT:COUN 8	
BB:GPS:GOC	
BB:GPS:SAT2:STAN?	GAL
BB:GPS:SAT2:SVID?	16
BB:GPS:SVID16:GAL:MPAT:TAP:COUN 2	
BB:GPS:SVID16:GAL:MPAT:TAP1:POW -3	
BB:GPS:SVID16:GAL:MPAT:TAP2:POW -5	
BB:GPS:SVID16:GAL:MPAT:STAT ON	
BB:GPS:SAT2:STAT ON	
BB:GPS:POW:MODE AUTO	
BB:GPS:POW:SREF 1	
BB:GPS:SAT1:STAN?	GPS
BB:GPS:POW:REF -115	
BB:GPS:POW:INT:PZER	
BB:GPS:STAT ON	
BB:GPS:SAT2:POW?	-1.12515425371262
BB:GPS:POW:INT:PST	
BB:GPS:POW:INT:CAE1D?	-2.44
BB:GPS:SAT2:POW?	0.374845746287383
:POW -110	
BB:GPS:POW:TOT?	-114.146761435285

<subsystem>:POWer:MODE.....	153
<subsystem>:POWer:REFeRence.....	153
<subsystem>:POWer:SREFeRence.....	154
<subsystem>:SATellite<st>:POWer.....	154
<subsystem>:SATellite<st>:POWer:RSIGnal.....	154
<subsystem>:POWer:TOTal.....	154
<subsystem>:POWer:INTEr:PZERo.....	155
<subsystem>:POWer:INTEr:PSTandard.....	155
<subsystem>:POWer:INTEr:CARCA.....	155
<subsystem>:POWer:INTEr:CAE1Def.....	155
<subsystem>:POWer:INTEr:GPS:PZERo.....	155
<subsystem>:POWer:INTEr:GPS:PSTandard.....	156
<subsystem>:POWer:INTEr:GPS:CAP.....	156

<subsystem>:POWer:MODE <Mode>

Determines whether the power is calculated automatically or is based on user defined settings.

Parameters:

<Mode> USER | AUTO

USER

User power mode, intended for dynamical configuration of the power of each satellite separately and manually.

AUTO

In auto power mode the power of all satellites is calculated automatically based on the satellite-to-receiver distance and relative to the relative power of the reference satellite (<subsystem>:POWer:SREFeRence).

*RST: USER

Example: See [example "Configuring the power settings"](#) on page 152.

<subsystem>:POWer:REFeRence <ReferencePower>

Sets the power level that is used as a reference for the calculation of the power level of the satellites.

Parameters:

<ReferencePower> float
 Range: -145 to 20
 Increment: 0.01
 *RST: -30
 Default unit: dBm

Example: See [example "Configuring the power settings"](#) on page 152.

<subsystem>:POWER:SREference <sat>

Determines the satellite used as a reference for the calculation of the power levels of the satellites in auto power mode.

Parameters:

<sat> float
 Range: 1 to 24
 Increment: 1
 *RST: 1

Example: See [example "Configuring the power settings"](#) on page 152.

<subsystem>:SATellite<st>:POWER <Power>

Sets/queries the power offset of the satellite in dB. The offset determines the power ratio of the activated satellites.

This setting command is only available for `<subsystem>:SMODE USER`.

See [chapter 3.4.1, "Power Configuration"](#), on page 55 for information about the power calculation.

Parameters:

<Power> float
 Range: -20 to 20 dB (for the query command) / 0 dB (for the settings command)
 Increment: 0.01
 *RST: 0

Example: See [example "Configuring the power settings"](#) on page 152.

<subsystem>:SATellite<st>:POWER:RSIGNAL? <RefSignal>

For mixed signals like "C/A+P", queries the signal used as a reference by power calculation.

The power reference is fixed to "C/A" for mixed signals. For signals modulated only with the P code, the power reference is "P".

Parameters:

<RefSignal> CA | P
 *RST: CA

Usage: Query only

Options: R&S SMBV-K93

<subsystem>:POWER:TOTAL?

Queries the total power of the GNSS signal.

Return values:

<Power> float
 Range: -145 to 30
 Increment: 0.01
 *RST: 0
 Default unit: dBm

Example: See [example "Configuring the power settings"](#) on page 152.

Usage: Query only

<subsystem>:POWER:INTER:PZERo

Sets the Inter-Standard Power relations to 0 dB.

Example: See [example "Configuring the power settings"](#) on page 152.

Usage: Event

<subsystem>:POWER:INTER:PSTandard

Sets the power relation between the signals belonging to the different navigation standard according to the relation determined in the specifications.

Example: See [example "Configuring the power settings"](#) on page 152.

Usage: Event

<subsystem>:POWER:INTER:CARCA <CA_RCA>**<subsystem>:POWER:INTER:CAE1Def <CA_E1Def>**

Sets the power relation between the signals belonging to the different navigation standards. The power level of the GPS signal C/A is used as reference.

Parameters:

<CA_E1Def> float
 Range: -6 to 0
 Increment: 0.01
 *RST: -1.5
 Default unit: dB

Example: See [example "Configuring the power settings"](#) on page 152.

<subsystem>:POWER:INTRa:GPS:PZERo

Sets the power relations between the signal components to 0 dB.

Usage: Event

Options: R&S SMBV-K93

<subsystem>:POWER:INTRa:GPS:PStandard

Sets the power relation between the signals belonging to the same navigation standard according to the relation determined in the specifications.

Usage: Event

Options: R&S SMBV-K93

<subsystem>:POWER:INTRa:GPS:CAP <CA_P>

Sets the power relation between the signals belonging to the same navigation standard.

Parameters:

<CA_P> float
 Range: 0 to 6
 Increment: 0.01
 *RST: 3

4.11 Navigation Message Configuration

Suffixes

The suffix index **SVID<ch>** distinguishes between the SV IDs

Value range: 1 .. 37 for GPS satellites and 1.. 50 for Galileo satellite; the SV ID must correspond to a healthy satellite!

The suffix index **PAGE<us>** distinguishes between the navigation pages.

Value range: 1 .. 12

<subsystem>:SVID<ch>:<GNSS>:NMESsage:PAGE:COUNT.....	159
<subsystem>:SVID<ch>:GALileo:NMESsage:PAGE:COUNT.....	159
<subsystem>:SVID<ch>:GLONass:NMESsage:PAGE:COUNT.....	159
<subsystem>:SVID<ch>:GPS:NMESsage:PAGE:COUNT.....	159
<subsystem>:SVID<ch>:<GNSS>:NMESsage:PRESet.....	159
<subsystem>:SVID<ch>:GALileo:NMESsage:PRESet.....	159
<subsystem>:SVID<ch>:GLONass:NMESsage:PRESet.....	159
<subsystem>:SVID<ch>:GPS:NMESsage:PRESet.....	159
<subsystem>:SVID<ch>:<GNSS>:NMESsage:PROJect.....	159
<subsystem>:SVID<ch>:GALileo:NMESsage:PROJect.....	159
<subsystem>:SVID<ch>:GLONass:NMESsage:PROJect.....	159
<subsystem>:SVID<ch>:GPS:NMESsage:PROJect.....	159
<subsystem>:SVID<ch>:<GNSS>:NMESsage:RTPRojection.....	159
<subsystem>:SVID<ch>:GALileo:NMESsage:RTPRojection.....	159
<subsystem>:SVID<ch>:GLONass:NMESsage:RTPRojection.....	160
<subsystem>:SVID<ch>:GPS:NMESsage:RTPRojection.....	160
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:CCORrection:AF<s2us0>.....	160
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:CCORrection:TGD.....	160

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:CCORrection:TOC.....	161
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:AODO.....	161
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	161
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	161
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIC.....	161
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	161
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	161
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIS.....	161
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CLTMode.....	162
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	162
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	162
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CRC.....	162
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	162
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	162
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CRS.....	162
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	163
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	163
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CUC.....	163
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	163
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	163
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CUS.....	163
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	163
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	163
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:ECCentricity.....	163
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:FIFLag.....	163
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:HEALTH.....	164
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	164
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	164
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IDOT.....	164
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IODA.....	164
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IODC.....	164
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IODE.....	164
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IODNav.....	165
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IZERO.....	165
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IZERO.....	165
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IZERO.....	165
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:LTPData.....	165
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:MZERO.....	165
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:MZERO.....	165
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:MZERO.....	165
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:NDELta.....	166
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:NDELta.....	166
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:NDELta.....	166
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:ODOT.....	166
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:ODOT.....	166
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:ODOT.....	166
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:OMEGa.....	166
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:OMEGa.....	166
<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:OMEGa.....	166
<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:OZERO.....	167

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:OZERO.....	167
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:OZERO.....	167
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris: SF1Reserved<s2us>.....	167
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:SISA.....	167
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:SQRA.....	167
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:SQRA.....	167
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:SQRA.....	167
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:SVConfig.....	168
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:TOE.....	168
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:TOE.....	168
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:TOE.....	168
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:URA.....	168
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:AF<s2us0>.....	168
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:BGD.....	169
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5ADVS.....	169
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:E5AHS.....	169
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:K.....	169
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:TOC.....	170
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:AF<s2us0>.....	170
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:BGD.....	170
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BDVS.....	171
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BHS.....	171
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BDVS.....	171
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BHS.....	171
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:TOC.....	171
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:DTAU.....	172
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:EN.....	172
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:GAMN.....	172
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:CCORrection:TAUN.....	172
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:AOEP.....	173
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:HEALth.....	173
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:P.....	173
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:SEType.....	174
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:TALignment.....	174
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:TINdex.....	174
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:TINterval.....	175
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:TOE.....	176
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:URA.....	176
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:XN.....	176
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:YN.....	176
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:ZN.....	176
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:XDDN.....	177
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:YDDN.....	177
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:ZDDN.....	177
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:XDN.....	177
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:YDN.....	177
<subsystem>:SVID<ch>:GLONass:NMESsage[:PAGE<us>]:EPHemeris:ZDN.....	177

<subsystem>:SVID<ch>:<GNSS>:NMESSage:PAGE:COUNT
<subsystem>:SVID<ch>:GALileo:NMESSage:PAGE:COUNT <NumberOfPages>
<subsystem>:SVID<ch>:GLONass:NMESSage:PAGE:COUNT <NumberOfPages>
<subsystem>:SVID<ch>:GPS:NMESSage:PAGE:COUNT <NumberOfPages>

Number of navigation pages. Several navigation pages are available per satellite.

If a RINEX file is used, the value of this parameter is retrieved from the file. A RINEX file may contain ephemeris information for up to 24 hours. Since the ephemeris are updated every two hours, the RINEX file contains a maximum number of 12 navigation pages.

This setting is only available for `<subsystem>:SMODE` USER.

Parameters:

<NumberOfPages> float
 Range: 1 to 12
 Increment: 1
 *RST: 1

Options: R&S SMBV-K65

<subsystem>:SVID<ch>:<GNSS>:NMESSage:PRESet
<subsystem>:SVID<ch>:GALileo:NMESSage:PRESet
<subsystem>:SVID<ch>:GLONass:NMESSage:PRESet
<subsystem>:SVID<ch>:GPS:NMESSage:PRESet

The navigation message's parameters are calculated according to the selected almanac.

This setting is only available for `<subsystem>:SMODE` USER.

Usage: Event

<subsystem>:SVID<ch>:<GNSS>:NMESSage:PROJect
<subsystem>:SVID<ch>:GALileo:NMESSage:PROJect
<subsystem>:SVID<ch>:GLONass:NMESSage:PROJect
<subsystem>:SVID<ch>:GPS:NMESSage:PROJect

Triggers the projection of the parameters of the navigation message. The values of the TOE and TOC are calculated according to the selected current simulation time (for "System Time UTC").

For details see "[Project Navigation Message](#)" on page 78

This setting is only available for `<subsystem>:SMODE` USER.

Usage: Event

<subsystem>:SVID<ch>:<GNSS>:NMESSage:RTPROjection
<subsystem>:SVID<ch>:GALileo:NMESSage:RTPROjection <State>

<subsystem>:SVID<ch>:GLONass:NMEssage:RTPProjection <State>
<subsystem>:SVID<ch>:GPS:NMEssage:RTPProjection <State>

Enables the instrument to internally perform a projection of the navigation message whenever this message is approaching its validity limit.

For details see ["Real-Time Projection"](#) on page 78.

This setting is only available for `<subsystem>:SMODE USER` and `<subsystem>:SATellite:GRTPProjection OFF`.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 0

Options: R&S SMBV-K65

<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:CCORrection:AF<s2us0>
<Af>

Defines the clock correction parameters `a_f2`, `a_f1`, `a_f0`.

Suffix:

<s2us0> a_f2, a_f1, a_f0
 Correction parameter name

Parameters:

<Af> integer
 Range: -128 to 127
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:CCORrection:TGD <Tgd>

Defines the L1-L2 Correction Term. As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)" (see `<subsystem>:SATellite<st>:TSHift` on page 151, `<subsystem>:SATellite<st>:DSHift` on page 147, `<subsystem>:SATellite<st>:DURATION` on page 147).

Parameters:

<Tgd> integer
 Range: -128 to 127
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:CCORrection:TOC <Toc>

Defines the Clock Correction Parameter. As this parameter affects the satellite's orbit, the value selected here also has an impact on the satellite's parameters "Time Shift", "Doppler Shift" and "Duration (Elevation>2.5/5/7.5/10°)" (see [<subsystem>:SATellite<st>:TSHift](#) on page 151, [<subsystem>:SATellite<st>:DSHift](#) on page 147, [<subsystem>:SATellite<st>:DURATION](#) on page 147).

This setting is only available for [<subsystem>:SMODE](#) USER.

Parameters:

<Toc> integer
 Range: 0 to 65535
 Increment: 1
 *RST: 0

Options: R&S SMBV-K65

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:AODO <Aodo>

Age of Data Offset

Parameters:

<Aodo> integer
 Range: 0 to 31
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIC

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIC <Cic>

Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination

Parameters:

<Cic> integer
 Range: -32768 to 32767
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:CIS

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:CIS <Cis>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:CIS <Cis>

Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination

Parameters:

<Cis> integer
 Range: -32768 to 32767
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:CLTMode
 <CLTMode>**

Type of code for L2; This value does not have any impact on the actual used ranging code of the generated satellite.

Parameters:

<CLTMode> REServed | PCODE | CACode

REServed
 Reserved for future use.

PCODE
 Carrier L2 (f_{L2}= 1.2276 GHz) is modulated by P-code (BPSK).

CACode
 Carrier L2 (f_{L2}= 1.2276 GHz) is modulated by C/A-code (BPSK).

*RST: PCODE

**<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:CRS
 <subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:CRS <Crc>
 <subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:CRS <Crc>**

Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius

Parameters:

<Crc> integer
 Range: -32768 to 32767
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:CRS
 <subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:CRS <Crs>
 <subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:CRS <Crs>**

Amplitude of the Sine Harmonic Correction Term to the Orbit Radius

Parameters:

<Crs> integer
 Range: -32768 to 32767
 Increment: 1
 *RST: 0

```

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CUC
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CUC <Cuc>
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CUC <Cuc>

```

Amplitude of the Cosine Harmonic Correction Term to the Argument of Latitude

Parameters:

```

<Cuc>                integer
                    Range:    -32768 to 32767
                    Increment: 1
                    *RST:    0

```

```

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:CUS
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:CUS <Cus>

```

Amplitude of the Sine Harmonic Correction Term to the Argument of Latitude

Parameters:

```

<Cus>                integer
                    Range:    -32768 to 32767
                    Increment: 1
                    *RST:    0

```

```

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:
  ECCentricity
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:
  ECCentricity <Eccentricity>
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:ECCentricity
  <Eccentricity>

```

Eccentricity

Parameters:

```

<Eccentricity>      integer
                    Range:    0 to 4294967295
                    Increment: 1
                    *RST:    0

```

```

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:FIFLag
  <FiFlag>

```

Indicates the curve-fit interval used by the CS (Control Segment) in determining the ephemeris parameters

Parameters:

```

<FiFlag>            0 | 1 | OFF | ON
                    *RST:    0

```

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:HEALTH
<Health>

This value does not have an impact on the actual health status of the generated satellite.

Parameters:

<Health> integer
 Range: 0 to 31
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:IDOT
<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IDOT
 <Idot>

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IDOT <Idot>

Rate of Inclination Angle

Parameters:

<Idot> integer
 Range: -8192 to 8191
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:IODA
 <Ioda>

Issue Of Data (Almanacs)

Parameters:

<Ioda> integer
 Range: 0 to 15
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IODC <Iodc>

Issue of Data, Clock

Parameters:

<Iodc> integer
 Range: 0 to 1023
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:IODE <Iode>

Issue of Data, Ephemeris

Parameters:

<lode> integer
 Range: 0 to 255
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IODNav
 <lodnav>

Issue Of Data (Ephemeris and Clock correction)

Parameters:

<lodnav> integer
 Range: 0 to 1023
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:IZERo

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:IZERo
 <lzero>

<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:IZERo <lzero>

Inclination Angle at Reference Time

Parameters:

<lzero> integer
 Range: -2147483648 to 2147483647
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:LTPData
 <LtpData>

Use of carrier L2 P data flag

This value does not have an impact on whether data is really transmitted on the satellite's carrier L2 or not.

Parameters:

<LtpData> 0 | 1 | OFF | ON
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMEssage[:PAGE<us>]:EPHemeris:MZERo

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:EPHemeris:MZERo
 <MZero>

<subsystem>:SVID<ch>:GPS:NMEssage[:PAGE<us>]:EPHemeris:MZERo
 <MZero>

Mean Anomaly at Reference Time

Parameters:

<MZero> integer
 Range: -2147483648 to 2147483647
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:NDELta
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:NDELta
 <NDelta>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:NDELta
 <NDelta>

Mean Motion Difference From Computed Value

Parameters:

<NDelta> integer
 Range: -32768 to 32767
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:ODOT
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:ODOT
 <ODot>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:ODOT <ODot>

Rate of Right Ascension

Parameters:

<ODot> integer
 Range: -8388608 to 8388607
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:OMEGa
 <subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:OMEGa
 <Omega>

<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:OMEGa
 <Omega>

Argument of Perigee

Parameters:

<Omega> integer
 Range: -2147483648 to 2147483647
 Increment: 1
 *RST: 0

```
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:OZERo
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:OZERo
<OZero>
```

```
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:OZERo
<OZero>
```

Longitude of Ascending Node of Orbit Plane at Weekly Epoch

Parameters:

```
<OZero>          integer
                  Range:    -2147483648 to 2147483647
                  Increment: 1
                  *RST:     0
```

```
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:
SF1Reserved<s2us> <Reserved>
```

SF1 Reserved 1/2/3/4

Suffix:

```
<s2us>          1 | 2 | 3 | 4
```

Parameters:

```
<Reserved>     integer
                  Range:    0 to 67108864
                  Increment: 1
                  *RST:     0
```

```
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:SISA
<Sisa>
```

Signal In Space Accuracy

Parameters:

```
<Sisa>         integer
                  Range:    0 to 255
                  Increment: 1
                  *RST:     0
```

```
<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:SQRA
```

```
<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:EPHemeris:SQRA
<SqrA>
```

```
<subsystem>:SVID<ch>:GPS:NMESsage[:PAGE<us>]:EPHemeris:SQRA <SqrA>
```

Square Root of the Semi-Major Axis

Parameters:

<SqrA> integer
 Range: 100000 to 4294967295
 Increment: 1
 *RST: 100000

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:SVConfig
 <SvConfig>

(A-S) Flags and SV Configurations

Parameters:

<SvConfig> integer
 Range: 0 to 15
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:<GNSS>:NMESSage[:PAGE<us>]:EPHemeris:TOE
 <subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:EPHemeris:TOE <ToE>
 <subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:TOE <ToE>

Time Of Ephemeris

Parameters:

<ToE> integer
 Range: 0 to 65535
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GPS:NMESSage[:PAGE<us>]:EPHemeris:URA <Ura>

SV accuracy / URA Index

Parameters:

<Ura> integer
 Range: 0 to 15
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESSage[:PAGE<us>]:FNAV:AF<s2us0> <Af>

Defines the SV clock drift rate correction coefficients a_{f0} , a_{f1} , a_{f2} (E1,E5a) of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Suffix:

<s2us0> 0 = a_{f0} , 1 = a_{f1} , 2 = a_{f2}
 Correction parameter name

Parameters:

<Af> integer
 Value range for af2: $-2^5 \dots 2^5-1$
 Value range for af1: $-2^{20} \dots 2^{20}-1$
 Value range for af0: $-2^{30} \dots 2^{30}-1$
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:FNAV:BGD <B_GD>

Defines the E1-E5a Broadcast Group Delay parameters "BGD(E1,E5a)" of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Parameters:

<B_GD> integer
 Range: -512 to 511
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:FNAV:E5ADVS <Dvs>

Defines the Data Validity Satellite Status, transmitted on E5a ($E5a_{DVS}$) of the freely accessible navigation message F/NAV.

Parameters:

<Dvs> integer
 Range: 0 to 1
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:FNAV:E5AHS <Hs>

Defines the Signal Health Status for E5a ($E5a_{HS}$) of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Parameters:

<Hs> integer
 Range: 0 to 3
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMEssage[:PAGE<us>]:FNAV:K <K>

Defines the F-NAV Almanac Scheduling start index of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Parameters:

<K> integer
 Range: 0 to 3
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:FNAV:TOC <Toc>

Defines the Clock correction data reference Time of Week "t_{oc}(E1,E5a)" of the freely accessible navigation message F/NAV, provided by the E5a signal for Open Service.

Parameters:

<Toc> integer
 Range: 0 to 16383
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:AF<s2us0> <Af>

Defines the SV clock drift rate correction coefficients a_{f0} , a_{f1} , a_{f2} (E1,E5b) of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Suffix:

<s2us0> 0 = a_{f2}, 1 = a_{f1}, 2 = a_{f0}
 Correction parameter name

Parameters:

<Af> integer
 Value range for af2: $-2^5 \dots 2^5-1$
 Value range for af1: $-2^{20} \dots 2^{20}-1$
 Value range for af0: $-2^{30} \dots 2^{30}-1$
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:BGD <Bgd>

Defines the E1-E5b Broadcast Group Delay "BGD (E1,E5b)" parameter of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Parameters:

<Bgd> integer
 Range: -2^9 to 2^9-1
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BDVS <Dvs>

Defines the Data Validity Satellite Status, transmitted on E1-B ("E1-B_{DVS}") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Parameters:

<Dvs> integer
 Range: 0 to 1
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E1BHS <hs>

Defines the Signal Health Status for E1 ("E1-B_{HS}") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Parameters:

<hs> integer
 Range: 0 to 3
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BDVS <Dvs>

Defines the Data Validity Satellite Status, transmitted on E5b ("E5b_{DVS}") of the Integrity navigation message I/NAV.

Parameters:

<Dvs> integer
 Range: 0 to 1
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:E5BHS <Hs>

Defines the Signal Health Status for E5b ("E5b_{HS}") of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Parameters:

<Hs> integer
 Range: 0 to 3
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GALileo:NMESsage[:PAGE<us>]:INAV:TOC <Toc>

Defines the Clock correction data reference Time of Week "t_{oc}(E1,E5b)" parameter of the Integrity navigation message I/NAV provided by E5b and E1-B signals.

Parameters:

<Toc> integer
 Range: 0 to $2^{14}-1$
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:DTAU
 <Delta_TAU_n>**

Defines the time difference between navigation RF signal transmitted in L2 and navigation RF signal transmitted in L1 band.

Parameters:

<Delta_TAU_n> integer
 Range: -16 to 15
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:EN
 <E_n>**

Sets the age of operation information.

Parameters:

<E_n> integer
 Range: 0 to 31
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:GAMN
 <GAMMA_n>**

Defines the SV Clock drift correction coefficient.

Parameters:

<GAMMA_n> integer
 Range: -1024 to 1023
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:CCORrection:TAUN
 <TAU_n>**

Defines the SV Clock bias correction coefficient.

Parameters:

<TAU_n> integer
 Range: -2097152 to 2097151
 Increment: 1
 *RST: 0

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:AOEP
 <AgeOfEph>**

Sets the time interval between 2 adjacent values of TOE. It defines hence the age of the current GLONASS Ephemeris page.

Parameters:

<AgeOfEph> A30M | A45M | A60M
A30M
 age of Ephemeris = 30 min
A45M
 age of Ephemeris = 45 min
A60M
 age of Ephemeris = 60 min
 *RST: A30M

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:HEALTH
 <Health>**

A health value. The user navigation equipment analyzes only the MSB of this word.

Parameters:

<Health> integer
B_n[3] = 1_n = 1
 Satellite is not healthy
B_n[3] = 1_n = 0
 Satellite is healthy
 Range: 0 to 7
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:P <P>

Reliability measure of system time conversion parameters.

Parameters:

<P> integer

00
TAU_C and TAU_GPS relayed from control segment.

01
TAU_C from control segment; TAU_GPS calculated on board GLONASS-M satellite.

10
TAU_C on board Glonass-M satellite and TAU_GPS relayed from CS.

11
TAU_C and TAU_GPS calculated on board Glonass-M satellites.

Range: 0 to 3
Increment: 1
*RST: 0

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:SEType
<Type>

Selects the satellite ephemeris type.

Parameters:

<Type> GLO | GLOM
*RST: GLOM

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:
TALignment <TbAlign>

Sets TOE to be aligned to an even or odd scale of 15 min for Age of Ephemeris = 30 or 60 min.

The parameters **Tb-Interval** ([<subsystem>:SVID<ch>:GLONass:NMESSage\[:PAGE<us>\]:EPHemeris:TInterval](#)) and **TOE** ([<subsystem>:SVID<ch>:GLONass:NMESSage\[:PAGE<us>\]:EPHemeris:TOE](#)) depend on this value.

Note: All Ephemeris pages of an SVID have the same Tb alignment (P2).

Parameters:

<TbAlign> EVEN | ODD
*RST: ODD

Example: SUR:BB:GLON:SVID:GLON:NMES:EPH:TAL EVEN

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TINdex
<TbIndex>

Defines the index of the Tb-time interval. Time of Ephemeris (TOE) corresponds to this value multiplied by 15 minutes. This value is actually a scaled TOE value with a unit of 15 minutes.

Note: Tb-Interval and TOE depend on this value.

Condition to be always met:

- (Tb-Index – 1)
should be an integer multiple of (Age of Ephemeris[min] / 15)
- Case 1:
Age of Ephemeris = 30 min
Tb-Index = 1,3,5,95
- Case 2:
Age of Ephemeris=45 min
Tb-Index = 1,4,7,94
- Case 3:
Age of Ephemeris = 60 min
Tb-Index = 1,5,9,93

Duration of the Tb-time interval is defined in the `<subsystem>:SVID<ch>:GLONass:NMEsSage[:PAGE<us>]:EPHemeris:AOEP` parameter.

Parameters:

<code><TbIndex></code>	integer
	Range: 1 to 95
	Increment: 1
	*RST: 1

`<subsystem>:SVID<ch>:GLONass:NMEsSage[:PAGE<us>]:EPHemeris:TInterval?`

Queries the Tb-Interval in the current day where the Ephemeris set page is valid.

$$\text{Tb-Interval} = \left[\frac{((\text{Tb} - 1 + \text{P2}) * 15 * 60) - \text{AgeOfEphemeris}}{2} \right. \\ \left. \frac{((\text{Tb} - 1 + \text{P2}) * 15 * 60) + \text{AgeOfEphemeris}}{2} \right]$$

Examples:

- tb = 45, P2 = 1 and Age of Eph = 30
Tb-Interval = [11:00:00 11:30:00]
- tb = 45, P2 = 1 and Age of Eph = 45
Tb-Interval = [10:52:30 11:37:30]
- tb = 45, P2 = 0 and Age of Eph = 60
Tb-Interval=[10:30:00 11:30:00]

Return values:

<code><TbInterval></code>	string
---------------------------------	--------

Example:

```
SUR:BB:GLON:SVID:GLON:NMES:EPH:TIND 0
set Tb_index to 0.
SOUR:BB:GLON:SVID:GLON:NMES:EPH:AOEP 30
set age of Ephemeris to 30 min.
SOUR:BB:GLON:SVID:GLON:NMES:EPH:TINT?
Response: Tb-Interval is the interval between 00:00:00 and
00:30:00 in the current day.
```

Usage: Query only

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:TOE?

Queries the time of Ephemeris in the current day. Also referred to in the standard as the middle of the Tb-Interval or tb.

This parameter is equivalent to $\text{DayTime}[(\text{Tb} - 1 + \text{P2}) * 15 * 60 \text{ seconds}]$ and independent of Age of Ephemeris.

Examples:

- tb = 45, P2 = 1
- tb = 45, P2 = 1
- tb = 45, P2 = 0
TOE = 11:00:00

Return values:

<Hour>	integer
	Range: 0 to 23
	Increment: 1
<Minute>	integer
	Range: 0 to 59
	Increment: 1
<Second>	float
	Range: 0 to 59
	Increment: 1

Usage: Query only

**<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:URA
<SvAcc>**

Provides the predicted satellite user range accuracy (URA).

Parameters:

<SvAcc>	integer
	Range: 0 to 15
	Increment: 1
	*RST: 0

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:XN <X_n>

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:YN <Y_n>

<subsystem>:SVID<ch>:GLONass:NMESSage[:PAGE<us>]:EPHemeris:ZN <Z_n>

Sets the OX | OY | OZ **position** coordinates of the current satellite at TOE(tb), i.e. the middle of Tb-Interval.

The coordinates correspond to the PZ-90 coordinate system.

Parameters:

<Z_n> integer
 Range: -67108864 to 67108863
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:XDDN
 <XDDOT_n>

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:YDDN
 <YDDOT_N>

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:ZDDN
 <ZDDOT_n>

The OZ **acceleration** coordinate of the current satellite due to solar and lunar gravitational effects at TOE(tb), i.e. the middle of Tb-Interval.

The coordinates correspond to the PZ-90 coordinate system.

Parameters:

<ZDDOT_n> integer
 Range: -16 to 15
 Increment: 1
 *RST: 0

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:XDN
 <XDOT_n>

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:YDN
 <YDOT_n>

<subsystem>:SVID<ch>:GLONass:NMEssage[:PAGE<us>]:EPHemeris:ZDN
 <ZDOT_n>

Sets the OX | OY | OZ **velocity** coordinate of the current satellite at TOE(tb), i.e. the middle of Tb-Interval⁽¹⁾.

The coordinates correspond to the PZ-90 coordinate system.

Parameters:

<ZDOT_n> integer
 Range: -8388608 to 8388607
 Increment: 1
 *RST: 0

4.12 Atmospheric Configuration

<subsystem>:ATMospheric:GALileo:TROPospheric:MODEl.....	178
<subsystem>:ATMospheric:GLONass:TROPospheric:MODEl.....	178
<subsystem>:ATMospheric:GPS:TROPospheric:MODEl.....	178
<subsystem>:ATMospheric:GPS:IONospheric:MODEl.....	178
<subsystem>:ATMospheric:GPS:IONospheric:ALPHA<ch0>.....	178

<subsystem>:ATMospheric:GPS:IONospheric:BETA<ch0>.....	178
<subsystem>:ATMospheric:GLONass:IONospheric:MODEl.....	179
<subsystem>:ATMospheric:GALileo:IONospheric:MODEl.....	179
<subsystem>:ATMospheric:GALileo:IONospheric:AI<ch0>.....	179
<subsystem>:ATMospheric:GALileo:IONospheric:SF<ch>.....	179

<subsystem>:ATMospheric:GALileo:TROPospheric:MODEl <Model>
<subsystem>:ATMospheric:GLONass:TROPospheric:MODEl <Model>
<subsystem>:ATMospheric:GPS:TROPospheric:MODEl <Model>

Determines the tropospheric model.

Parameters:

<Model> NONE | STANag
 *RST: NONE

<subsystem>:ATMospheric:GPS:IONospheric:MODEl <Model>

Determines the applied ionospheric model.

Parameters:

<Model> NONE | KLOBuchar
 *RST: NONE

<subsystem>:ATMospheric:GPS:IONospheric:ALPHA<ch0> <Alpha>

Sets the parameter alpha_0 .. alpha_3 of the satellite's navigation message.

Suffix:

<ch0> 0 .. 3

Parameters:

<Alpha> float
 Range: -128 to 127
 Increment: 1
 *RST: 0

<subsystem>:ATMospheric:GPS:IONospheric:BETA<ch0> <Beta>

Sets the parameter beta_0 .. beta_3 of the satellite's navigation message.

Suffix:

<ch0> 0 .. 3

Parameters:

<Beta> float
 Range: -128 to 127
 Increment: 1
 *RST: 0

Example: Generating of assistance data

SCPI command	Response
BB:GPS:SMOD USER	
BB:GPS:ADG:MODE GPS	
BB:GPS:ADG:GPS:SYNC	
BB:GPS:ADG:GPS:SVID15:STAT?	1
BB:GPS:ADG:GPS:LOC:COOR:DMS?	144,57,59.97,EAST,37,48,59.987,SOUT, 100
BB:GPS:ADG:GPS:LOC:COOR:DEC?	144.966658,-37.816663,100
BB:GPS:ADG:GPS:LOC:URAD 2500	
BB:GPS:ADG:GPS:TOAD:TBAS UTC	
BB:GPS:ADG:GPS:TOAD:DATE?	2010,11,7
BB:GPS:ADG:GPS:TOAD:TIME?	17,4,0
BB:GPS:ADG:GPS:TOAD:TBAS GPS	
BB:GPS:ADG:GPS:TOAD:WNUM?	1609
BB:GPS:ADG:GPS:TOAD:TOW?	61455
BB:GPS:ADG:GPS:TOAD:DUR 10	
BB:GPS:ADG:GPS:TOAD:RES 0.001	
BB:GPS:ADG:ACQ:CRE '/var/user/ADG/acquisition'	
BB:GPS:ADG:ALM:CRE '/var/user/ADG/almanac.rs_al'	
BB:GPS:ADG:ALM:CRE '/var/user/ADG/almanac.rs_yuma'	
BB:GPS:ADG:UTC:CRE '/var/user/ADG/UTC'	
BB:GPS:ADG:NAV:CRE '/var/user/ADG/navigation'	
BB:GPS:ADG:NAV:CRE '/var/user/ADG/RINEX.110n'	
BB:GPS:ADG:ION:CRE '/var/user/ADG/ionospheric'	
MMEM:CAT? '<root>/ADG'	25301,43275001856,".,DIR,0","...",DIR, 0,"acquisition.rs_acq,BIN, 525","almanac.rs_al,BIN, 5518","almanac.rs_yuma,BIN, 18344","ion.rs_ion,BIN, 70","navigation.rs_nav,BIN, 245","RINEX.10n,BIN, 525","UTC.rs_utc,BIN,74"
<subsystem>:ADGeneration:GPS:SVID<ch>:ACQuisition:BLOCK.....	181
<subsystem>:ADGeneration:GPS:SVID<ch>:SAData.....	182
<subsystem>:ADGeneration:GPS:SVID:SYNChronize.....	183

<subsystem>:ADGeneration:GPS:LOCation:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:TOAData:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:SYNChronize.....	183
<subsystem>:ADGeneration:MODE.....	183
<subsystem>:ADGeneration:GPS:SVID<ch>:STATe.....	183
<subsystem>:ADGeneration:GPS:LOCation:COORdinates:DECimal.....	184
<subsystem>:ADGeneration:GPS:LOCation:COORdinates:DMS.....	184
<subsystem>:ADGeneration:GPS:LOCation:URADius.....	185
<subsystem>:ADGeneration:GPS:TOAData:TBASis.....	186
<subsystem>:ADGeneration:GPS:TOAData:DATE.....	186
<subsystem>:ADGeneration:GPS:TOAData:TIME.....	186
<subsystem>:ADGeneration:GPS:TOAData:DUration.....	187
<subsystem>:ADGeneration:GPS:TOAData:RESolution.....	187
<subsystem>:ADGeneration:GPS:TOAData:TOWeek.....	187
<subsystem>:ADGeneration:GPS:TOAData:WNUMber.....	188
<subsystem>:ADGeneration:ACQuisition:CREate.....	188
<subsystem>:ADGeneration:ALManac:CREate.....	188
<subsystem>:ADGeneration:UTC:CREate.....	189
<subsystem>:ADGeneration:NAVigation:CREate.....	189
<subsystem>:ADGeneration:IONospheric:CREate.....	189

<subsystem>:ADGeneration:GPS:SVID<ch>:ACQuisition:BLOCK? <TimeOffset>

Queries part of the current assistance data settings.

Query parameters:

<TimeOffset> Int
 Sets the offset of time to the beginning of the acquisition data generation set with the command `<subsystem>:ADGeneration:GPS:TOAData:TIME` or the command `<subsystem>:ADGeneration:GPS:TOAData:TOWeek`.

Return values:

<Block> <Rx Time of Week>,<Satellite ID that corresponds to the record>,<Zero Order Doppler Term>,<1st order Doppler Term>,<Uncertainty Doppler>,<Code Phase (or half-Chip index at epoch Time of Transmission (GPS Sat Time))>,<Integer Code Phase (or ms unit index at epoch Time of Transmission (GPS Sat Time))>,<Corresponding Bit number (modulo 4) at epoch Time of Transmission (GPS Sat Time)>,<Correlator Code phase Search Radius>,<Azimuth Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>,<Elevation Angle of the Satellite in ENU orthonormal coordinate System centered at reference point>
 The returned value is exactly one row of the acquisition assistance data file (2G, 3G) that can be generated by the command `<subsystem>:ADGeneration:ACQuisition:CREate`.

Example: BB:GPS:ADG:GPS:TOAD:TBAS UTC
 BB:GPS:ADG:GPS:TOAD:TIME 17,04,00.000
 sets the time of assistance data.
 BB:GPS:ADG:GPS:SVID2:ACQ:BLOC? 0.1
 queries the acquisition data for SV ID 2 and time offset of 0.1s, i.e.
 at UTC Time 17:04:00 + 0.1 s.
 Response:
 589925,5,3733.3371910282908,0,0,599,18,1,11,
 225.32801752395233,11.17712126071662

Usage: Query only

Options: R&S SMBV-K65

**<subsystem>:ADGeneration:GPS:SVID<ch>:SADData? <TimeOffset>,
 <NumberOfSymbols>**

Queries selected number of symbols from the sensitivity assistance message for a specific satellite (SV ID) and at given specific time.

Query parameters:

<TimeOffset> float

Sets the offset of time to the beginning of the acquisition data generation set with the command `<subsystem>:ADGeneration:GPS:TOADData:TIME` or the command

`<subsystem>:ADGeneration:GPS:TOADData:TOWeek`.

<NumberOfSymbols> Default unit: bits

Determines the length of the sensitivity assistance data to be generated. The maximum length of the generated sensitivity assistance data is then 125 subframes, i.e. 25 pages or one complete navigation message.

Return values:

<Data> list of floats

The R&S SMBV generates a sensitivity assistance message as a binary stream.

The returned value of this query for a healthy satellite is a sequence of integer values. The first integer is the size of the message in bits to be returned. The remaining, each of which is a 32 bits long block, represents the expected data bits of the navigation message.

The query returns 0, in case an unhealthy satellite has been selected.

An error will only be reported if an out of range value for any of the arguments has been selected.

Example: BB:GPS:ADG:GPS:TOAD:TBAS UTC
 BB:GPS:ADG:GPS:TOAD:TIME 17,04,00.000
 BB:GPS:ADG:GPS:SVID1:ACQ:SAD? 1,300
 queries the sensitivity assistance data for SV ID 1.
 Response: 0
 The selected satellite is unhealthy.
 BB:GPS:ADG:GPS:SVID2:ACQ:SAD? 2,300
 queries the sensitivity assistance data for SV ID 2.
 Response:
 300,-1962933360,78782016,68160383,-10752,43007,
 -172032,681727,-1009778689,-1
 The first bits of the sensitivity assistance message are 1000 1011
 ...

Usage: Query only

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:SVID:SYNChronize
<subsystem>:ADGeneration:GPS:LOCation:SYNChronize
<subsystem>:ADGeneration:GPS:TOAData:SYNChronize
<subsystem>:ADGeneration:GPS:SYNChronize

Synchronizes the affected parameters.

Example: See [example "Generating of assistance data"](#) on page 180.

Usage: Event

Options: R&S SMBV-K65

<subsystem>:ADGeneration:MODE <Mode>

Defines the type of assistance data to be loaded.

Parameters:

<Mode> GPS
 *RST: GPS

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:SVID<ch>:STATe <State>

Enables/disables a space vehicle with the selected SV ID for generation of assistance data.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: OFF

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:LOCation:COORDinates:DECimal <Longitude>, <Latitude>, <Altitude>

Sets the geographic reference location in decimal format.

Parameters:

<Longitude> float
 Range: -180 to 180
 Increment: 1E-6
 *RST: 0

<Latitude> float
 Range: -90 to 90
 Increment: 1E-6
 *RST: 0

<Altitude> float
 Defines the altitude in meters above sea level.
 Range: -10000 to 1600000
 Increment: 0.1
 *RST: 0

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:LOCation:COORDinates:DMS <LongitudeDeg>, <LongitudeMin>, <LongitudeSec>, <LongitudeDir>, <LatitudeDeg>, <LatitudeMin>, <LatitudeSec>, <LatitudeDir>, <Altitude>

Sets the geographic reference location in degrees, minutes and seconds.

Parameters:

<LongitudeDeg> integer
 Defines the longitude degrees.
 Range: 0 to 180
 Increment: 1
 *RST: 0

<LongitudeMin> integer
 Defines the longitude minutes.
 Range: 0 to 59
 Increment: 1
 *RST: 0

<LongitudeSec>	float Defines the longitude seconds. Range: 0 to 59.999 Increment: 0.001 *RST: 0
<LongitudeDir>	EAST WEST Defines the longitude direction. *RST: EAST
<LatitudeDeg>	integer Defines the latitude degrees. Range: 0 to 90 Increment: 1 *RST: 0
<LatitudeMin>	integer Defines the latitude minutes. Range: 0 to 59 Increment: 1 *RST: 0
<LatitudeSec>	float Defines the latitude seconds. Range: 0 to 59.999 Increment: 0.001 *RST: 0
<LatitudeDir>	NORTH SOUTH Defines the latitude direction. *RST: NORT
<Altitude>	float Defines the altitude in meters above sea level. Range: -10000 to 1600000 Increment: 0.1 *RST: 0
Example:	See example "Generating of assistance data" on page 180.
Options:	R&S SMBV-K65

<subsystem>:ADGeneration:GPS:LOCation:URADius <Radius>

Sets the Uncertainty Radius, i.e. sets the maximum radius of the area within which the two dimensional location of the UE is bounded.

Parameters:

<Radius> integer
 Range: 0 to 1.E6
 Increment: 1
 *RST: 3.E3

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:TBASis <TimeBasis>

Determines the time basis used to enter the time of assistance data parameters.

Parameters:

<TimeBasis> UTC | GPS
 *RST: UTC

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:DATE <Year>, <Month>, <Day>

Enabled for UTC time basis ([<subsystem>:ADGeneration:GPS:TOADData:TBASis](#)).

Enters the date for the assistance data in DMS format of the Gregorian calendar.

Parameters:

<Year> integer
 Range: 1980 to 9999
 Increment: 1

<Month> integer
 Range: 1 to 12
 Increment: 1

<Day> integer
 Range: 1 to 31
 Increment: 1

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:TIME <Hour>, <Minute>, <Second>

Enabled for UTC time basis ([<subsystem>:ADGeneration:GPS:TOADData:TBASis](#)).

Enters the exact start time for the assistance data in UTC time format.

Parameters:

<Hour>	integer
	Range: 0 to 23
	Increment: 1
<Minute>	integer
	Range: 0 to 59
	Increment: 1
<Second>	float
	Range: 0 to 59.999
	Increment: 0.001

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:DURATION <Duration>

Sets the duration of the assistance data.

Parameters:

<Duration>	float
	Range: 1E-3 s to 5E3 s
	Increment: 1E-3 s
	*RST: 1E-3 s
	Default unit: s

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:RESOLUTION <Resolution>

Sets the resolution of the assistance data.

Parameters:

<Resolution>	float
	Range: 1.0E-3 to 5
	Increment: 1.0E-3
	*RST: 1.0E-3
	Default unit: s

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOADData:TOWeek <TOW>

Enabled for GPS time basis ([<subsystem>:ADGeneration:GPS:TOADData:TBASis](#)).

Determines the Time of Week (TOW) the assistance data is generated for.

Parameters:

<TOW> integer
 Range: -604800 to 604800
 Increment: 1
 *RST: 0

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:GPS:TOAData:WNUMber <WeekNumber>

Enabled for GPS time basis ([<subsystem>:ADGeneration:GPS:TOAData:TBASis](#)).

Sets the week number (WN) the assistance data is generated for.

Parameters:

<WeekNumber> integer
 Range: 0 to 9999.0*53
 Increment: 1
 *RST: 0

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:ACQuisition:CREate <Create>

Stores the current assistance data settings into the selected acquisition file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as acquisition file with the specific file extensions `*.rs_acq`.

Parameters:

<Create> string

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:ALManac:CREate <Filename>

Stores the current assistance data settings into the selected almanac file. The directory is set using command `M MEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as almanac file with the specific file extensions `*.rs_al` or `*.rs_yuma`.

The default extension is `*.rs_al` and can be omitted in the file name.

To save an almanac file as file with extension `*.rs_yuma`, however, this extension has to be specified in the file name.

Parameters:

<Filename> string

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:UTC:CREate <Filename>

Stores the current assistance data settings into the selected UTC file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as UTC file with the specific file extensions `*.rs_utc`.

Parameters:

<Filename> string

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:NAVigation:CREate <Filename>

Stores the current assistance data settings into the selected navigation file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as navigation file with the specific file extensions `*.rs_nav` or into RINEX files with extension `.10n`.

Parameters:

<Filename> string

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

<subsystem>:ADGeneration:IONospheric:CREate <Filename>

Stores the current assistance data settings into the selected ionospheric file. The directory is set using command `MMEM:CDIRectory`. A path can also be specified, in which case the files in the specified directory are read. Only the file name has to be entered. Assistance data settings are stored as ionospheric file with the specific file extensions `*.rs_ion`.

Parameters:

<Filename> string

Example: See [example "Generating of assistance data"](#) on page 180.

Options: R&S SMBV-K65

4.14 S.P.O.T Configuration

<subsystem>:SPOT:UPDate <State>

Enables/disables the GUI updates.

Tip: GUI update is very time consuming operation. It is recommended to disabled it while working in remote control.

Parameters:

<State> 0 | 1 | OFF | ON
 *RST: 1

Example: see [example "Retrieving real-time settings"](#) on page 190

<subsystem>:SPOT:NHOTime?

In "Auto Localization" mode (<subsystem>:SMOD AUTO), queries the expected date and time of the upcoming satellites handover.

Return values:

<NHoTime> integer

Example: See [example "Retrieving real-time settings"](#) on page 190.

Usage: Query only

4.15 Real-Time Commands

The following example uses GPS entry standard.

Example: Retrieving real-time settings

SCPI Command	Response
BB:GPS:SPOT:UPD OFF	
BB:GPS:SPOT:NHOT?	1540
BB:GPS:RT:SCON? GPS,1609,61455	6,G11,E11,E19,E28,G19,G14,2035
BB:GPS:RT:OCON? GPS,1609,65455	6,G20,E20,E23,G4,G24,E31
BB:GPS:RT:RLOC:COOR:DMS? GSP,1609,61455	144,57,59.97,EAST,37,48,59.987,SOUT,100
BB:GPS:RT:RLOC:COOR:DEC? GPS,1609,61455	144.966658,-37.816663,100
BB:GPS:RT:GAL:SVID10:TAP0:POW:ABS? GST,1609,61455	-119.630448196624
BB:GPS:RT:GAL:SVID10:TAP1:POW:ABS? GST,1609,61455	-124.630448196624
BB:GPS:RT:GAL:SVID10:AZIM? GST,1609,61455	104.250020240497

SCPI Command	Response
BB:GPS:RT:GAL:SVID10:ELEV? GST,1609,61455	25.950153201359
BB:GPS:RT:HWTIme?	
<subsystem>:RT:HWTIme.....	191
<subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth.....	191
<subsystem>:RT:GALileo:SVID<ch>:AZIMuth.....	191
<subsystem>:RT:GLONass:SVID<ch>:AZIMuth.....	191
<subsystem>:RT:GPS:SVID<ch>:AZIMuth.....	191
<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation.....	192
<subsystem>:RT:GALileo:SVID<ch>:ELEVation.....	192
<subsystem>:RT:GLONass:SVID<ch>:ELEVation.....	193
<subsystem>:RT:GPS:SVID<ch>:ELEVation.....	193
<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute.....	194
<subsystem>:RT:GALileo:SVID<ch>:TAP<us>:POWER:ABSolute.....	194
<subsystem>:RT:GLONass:SVID<ch>:TAP<us>:POWER:ABSolute.....	194
<subsystem>:RT:GPS:SVID<ch>:TAP<us>:POWER:ABSolute.....	194
<subsystem>:RT:RLOCation:COORDinates:DECimal.....	195
<subsystem>:RT:RLOCation:COORDinates:DMS.....	197
<subsystem>:RT:SCONstellation.....	199
<subsystem>:RT:OCONstellation.....	200

<subsystem>:RT:HWTIme?

Queries the time elapsed since the simulation start.

Return values:

<ElapsedTime> float
 Range: 0 to INT_MAX
 Increment: 0.001
 *RST: 0

Example: See [example "Retrieving real-time settings"](#) on page 190

Usage: Query only

<subsystem>:RT:<GNSS>:SVID<ch>:AZIMuth

<subsystem>:RT:GALileo:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GLONass:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GPS:SVID<ch>:AZIMuth? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the satellite azimuth in the selected moment of time. The required query parameters, depend on the selected time basis.

Query parameters:

<TimeBasis> UTC | GPS | GST | GLO
 *RST: UTC

<Year>	integer required for UTC time basis only Range: 1980 to 9999 Increment: 1
<Month>	integer required for UTC time basis only Range: 1 to 12 Increment: 1
<Day>	integer required for UTC time basis only Range: 1 to 31 Increment: 1
<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1
<TimeOfWeek>	float required for GPS and GST time basis only Range: 0 to 604799.999 Increment: 0.001

Return values:

<Azimuth> float

Example: See [example "Retrieving real-time settings"](#) on page 190.

Usage: Query only

<subsystem>:RT:<GNSS>:SVID<ch>:ELEVation

<subsystem>:RT:GALileo:SVID<ch>:ELEVation? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GLONass:SVID<ch>:ELEVation? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

<subsystem>:RT:GPS:SVID<ch>:ELEVation? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the satellite's elevation in the selected moment of time. The required query parameters, depend on the selected time basis.

Query parameters:

<TimeBasis>	UTC GPS GST GLO *RST: UTC
<Year>	integer required for UTC time basis only Range: 1980 to 9999 Increment: 1
<Month>	integer required for UTC time basis only Range: 1 to 12 Increment: 1
<Day>	integer required for UTC time basis only Range: 1 to 31 Increment: 1
<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1
<TimeOfWeek>	float required for GPS and GST time basis only Range: 0 to 604799.999 Increment: 0.001

Return values:

<Elevation> float

Example:See [example "Retrieving real-time settings"](#) on page 190.**Usage:**

Query only

<subsystem>:RT:<GNSS>:SVID<ch>:TAP<us>:POWER:ABSolute**<subsystem>:RT:GALileo:SVID<ch>:TAP<us>:POWER:ABSolute?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>**<subsystem>:RT:GLONass:SVID<ch>:TAP<us>:POWER:ABSolute?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>**<subsystem>:RT:GPS:SVID<ch>:TAP<us>:POWER:ABSolute?** <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the absolute power of a specified Tap of a specific satellite at a selected moment of time.

Note: The power refers to the reference signal component in case of many signals simulated with this specific satellite e.g. C/A when simulating a satellite with signals (C/A + P)Q.**Suffix:**

<us> 1..10

Determines the tap number. The number of taps is set with the command `<subsystem>:SVID<ch>:GALileo:MPATH:TAP:COUNT`.**Query parameters:**

<TimeBasis> UTC | GPS | GST | GLO

*RST: UTC

<Year> integer

required for UTC time basis only

Range: 1980 to 9999

Increment: 1

<Month> integer

required for UTC time basis only

Range: 1 to 12

Increment: 1

<Day> integer

required for UTC time basis only

Range: 1 to 31

Increment: 1

<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1
<TimeOfWeek>	float required for GPS and GST time basis only Range: 0 to 604799.999 Increment: 0.001

Return values:

<Power> float

Example: See [example "Retrieving real-time settings"](#) on page 190.

Usage: Query only

<subsystem>:RT:RLOCation:COORDinates:DECimal? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the coordinates of the receiver location in decimal format for the selected moment of time. The required query parameters depend on the selected time basis.

Query parameters:

<TimeBasis>	UTC GPS GST GLO *RST: UTC
<Year>	integer required for UTC time basis only Range: 1980 to 9999 Increment: 1

<Month>	integer required for UTC time basis only Range: 1 to 12 Increment: 1
<Day>	integer required for UTC time basis only Range: 1 to 31 Increment: 1
<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1
<TimeOfWeek>	float required for GPS and GST time basis only Range: 0 to 604799.999 Increment: 0.001
Return values:	
<Longitude>	float Range: -180 to 180 Increment: 1E-6 *RST: 0
<Latitude>	float Range: -90 to 90 Increment: 1E-6 *RST: 0
<Altitude>	float Range: -10000 to 1600000 Increment: 0.1 *RST: 0

Example: See [example "Retrieving real-time settings"](#) on page 190.

Usage: Query only

<subsystem>:RT:RLOCation:COORDinates:DMS? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the coordinates of the receiver location in DMS format for the selected moment of time. The required query parameters depend on the selected time basis.

Query parameters:

<TimeBasis>	UTC GPS GST GLO *RST: UTC
<Year>	integer required for UTC time basis only Range: 1980 to 9999 Increment: 1
<Month>	integer required for UTC time basis only Range: 1 to 12 Increment: 1
<Day>	integer required for UTC time basis only Range: 1 to 31 Increment: 1
<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1

<TimeOfWeek> float
 required for GPS and GST time basis only
 Range: 0 to 604799.999
 Increment: 0.001

Return values:

<LongitudeDeg> integer
 Range: 0 to 180
 Increment: 1
 *RST: 0

<LongitudeMin> integer
 Range: 0 to 59
 Increment: 1
 *RST: 0

<LongitudeSec> float
 Range: 0 to 59.999
 Increment: 0.001
 *RST: 0

<LongitudeDir> EAST | WEST
 *RST: EAST

<LatitudeDeg> integer
 Range: 0 to 90
 Increment: 1
 *RST: 0

<LatitudeMin> integer
 Range: 0 to 59
 Increment: 1
 *RST: 0

<LatitudeSec> float
 Range: 0 to 59.999
 Increment: 0.001
 *RST: 0

<LatitudeDir> NORT | SOUT
 *RST: NORT

<Altitude> float
 Range: -10000 to 1600000
 Increment: 0.1
 *RST: 0

Example: See [example "Retrieving real-time settings"](#) on page 190.

Usage: Query only

<subsystem>:RT:SCONstellation? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the constellation of the active satellites for the selected moment of time.

Query parameters:

<TimeBasis>	UTC GPS GST GLO *RST: UTC
<Year>	integer required for UTC time basis only Range: 1980 to 9999 Increment: 1
<Month>	integer required for UTC time basis only Range: 1 to 12 Increment: 1
<Day>	integer required for UTC time basis only Range: 1 to 31 Increment: 1
<Hour>	integer required for UTC time basis only Range: 0 to 23 Increment: 1
<Minutes>	integer required for UTC time basis only Range: 0 to 59 Increment: 1
<Seconds>	float required for UTC time basis only Range: 0 to 59.999 Increment: 0.001
<WeekNumber>	integer required for GPS and GST time basis only Range: 0 to 529947 Increment: 1
<TimeOfWeek>	float required for GPS and GST time basis only Range: 0 to 604799.999 Increment: 0.001

Return values:

<Constellation> <Number of Sats>, <STD/SV ID of Sat1>, <STD/SV ID of Sat2>, ..., <Remaining Time>

The query returns a string composed of the number of simulated satellites at the selected moment of time, standard/SV-ID of all the satellites in the active constellation and if applicable the remaining time to the next exchange of satellites in seconds.

The <Remaining Time> is returned as a valid positive integer in seconds only when working in a mode where exchange of satellites is predefined or made automatic at the beginning of the simulation, e.g while working in the auto localization mode (<subsystem>:SMODE); otherwise -1 is returned.

Example:

```
BB:GPS:SMOD AUTO
```

```
BB:GPS:RT:SCON? GPS,1609,61455
```

```
Response: 6,G24,G10,G32,E11,E25,E14,1525
```

The 6 active satellites G24,G10,G32,E11,E25,E14 build the satellite constellation. An exchange of satellites will be performed in 1525s.

Example:

See also [example "Retrieving real-time settings"](#) on page 190.

Usage:

Query only

<subsystem>:RT:OCONstellation? <TimeBasis>, <Year>, <Month>, <Day>, <Hour>, <Minutes>, <Seconds>, <WeekNumber>, <TimeOfWeek>

Queries the optimal constellation for the selected moment of time.

Query parameters:

<TimeBasis> UTC | GPS | GST | GLO
*RST: UTC

<Year> integer
required for UTC time basis only
Range: 1980 to 9999
Increment: 1

<Month> integer
required for UTC time basis only
Range: 1 to 12
Increment: 1

<Day> integer
required for UTC time basis only
Range: 1 to 31
Increment: 1

<Hour> integer
 required for UTC time basis only
 Range: 0 to 23
 Increment: 1

<Minutes> integer
 required for UTC time basis only
 Range: 0 to 59
 Increment: 1

<Seconds> float
 required for UTC time basis only
 Range: 0 to 59.999
 Increment: 0.001

<WeekNumber> integer
 required for GPS and GST time basis only
 Range: 0 to 529947
 Increment: 1

<TimeOfWeek> float
 required for GPS and GST time basis only
 Range: 0 to 604799.999
 Increment: 0.001

Return values:

<Constellation> <Number of Sats>,<STD/SV ID of Sat1>,<STD/SV ID of Sat2>,...

The query returns a string composed of the number of satellites in the optimal constellation and the standard/SV-ID of the satellites. Use this information as a basis for manually performed exchange of satellites.

Example:

```
BB:GPS:SMOD USER
```

```
BB:GPS:NAV:SIM:TBAS GPS
```

```
BB:GPS:NAV:SIM:WNUM 1609
```

```
BB:GPS:NAV:SIM:TOW 61455
```

```
BB:GPS:GOC
```

```
BB:GPS:RT:SCON? GPS,1609,61455
```

```
Response: 6,G11,E11,E19,E28,G19,G14,-1
```

The 6 active satellites G11,E11,E19,E28,G19,G14 build the satellite constellation.

```
BB:GPS:RT:OCON? GPS,1609,65455
```

```
Response: 6,G20,E20,E23,G4,G24,E31
```

The optimal constellation for the selected moment of time consists of 6 satellites G20,E20,E23,G4,G24,E31.

Example:

See also [example "Retrieving real-time settings"](#) on page 190.

Usage:

Query only

4.16 Trigger Settings

EXTernal<ch>

The numeric suffix to **EXTernal<ch>** distinguishes between the external trigger via the TRIGGER 1 (suffix 1) and TRIGGER 2 (suffix 2) connector.

<subsystem>[:TRIGger]:SEQuence.....	202
<subsystem>:TRIGger:SLENgth.....	203
<subsystem>:TRIGger:RMODe.....	204
<subsystem>:TRIGger:ARM:EXECute.....	204
<subsystem>:TRIGger:EXECute.....	205
<subsystem>:TRIGger:SOURce.....	205
<subsystem>:TRIGger:EXTernal:SYNChronize:OUTPut.....	205
<subsystem>:TRIGger:OUTPut<ch>:DELay.....	206
<subsystem>:TRIGger:OUTPut<ch>:DELay:MINimum.....	206
<subsystem>:TRIGger:OUTPut<ch>:DELay:MAXimum.....	206
<subsystem>:TRIGger:OUTPut:DELay:FIXed.....	207
<subsystem>:TRIGger[:EXTernal<ch>]:DELay.....	207
<subsystem>:TRIGger[:EXTernal<ch>]:INHibit.....	207

<subsystem>[:TRIGger]:SEQuence <Sequence>

Selects the trigger mode.

Parameters:

<Sequence>

AUTO | RETRigger | AAUTo | ARETrigger | SINGLE

AUTO

The modulation signal is generated continuously.

RETRigger

The modulation signal is generated continuously. A trigger event (internal or external) causes a restart.

AAUTo

The modulation signal is generated only when a trigger event occurs. After the trigger event the signal is generated continuously. Signal generation is stopped with command

<subsystem>:TRIG:ARM:EXEC and started again when a trigger event occurs.

ARETrigger

The modulation signal is generated only when a trigger event occurs. The device automatically toggles to RETRIG mode. Every subsequent trigger event causes a restart.

Signal generation is stopped with command

<subsystem>:TRIG:ARM:EXEC and started again when a trigger event occurs.

SINGLE

The modulation signal is generated only when a trigger event occurs. Then the signal is generated once to the length specified with command <subsystem>:TRIG:SLEN. Every subsequent trigger event causes a restart.

*RST: AUTO

Example:

BB:GPS:SEQ AAUT

sets the "Armed_auto" trigger mode; the device waits for the first trigger (e.g. with *TRG) and then generates the signal continuously.

<subsystem>:TRIGger:SLENgth <SLength>

Defines the length of the signal sequence to be output in the "Single" trigger mode (SOUR:BB:GPS:SEQ SING). The unit of the entry is defined under "Signal Duration Unit". The maximum value for the sequence length depends on the selected unit.

It is possible to output deliberately just part of the signal, an exact sequence of the signal, or a defined number of repetitions of the signal.

Parameters:

<SLength>

integer

Range: 1 to 4294967295

Increment: 1

*RST: 1023

Example: `BB:GPS:SEQ SING`
sets trigger mode Single.
`BB:GPS:TRIG:SLEN 200`
sets a sequence length of 200 chips. The first 200 chips of the current frame will be output after the next trigger event.

<subsystem>:TRIGger:RMODe?

Queries the current status of signal generation for all trigger modes with GPS modulation on.

Return values:

<Rmode> STOP | RUN

RUN
the signal is generated. A trigger event occurred in the triggered mode.

STOP
the signal is not generated. A trigger event did not occur in the triggered modes, or signal generation was stopped by the command <subsystem>:TRIG:ARM:EXECute (armed trigger modes only).

Example: `BB:GPS:TRIG:MODE ARET`
selects the "Armed_Retrigger" mode.
`BB:GPS:TRIG:SOUR EXT`
sets external triggering via the TRIGGER 1 connector.
`BB:GPS:TRIG:RMOD?`
queries the current status of signal generation.
Response: RUN
the signal is generated, an external trigger was executed.

Usage: Query only

<subsystem>:TRIGger:ARM:EXECute

Stops signal generation for trigger modes "Armed_Auto" and "Armed_Retrigger". A subsequent internal or external trigger event restarts signal generation.

Example: `BB:GPS:TRIG:SOUR INT`
sets internal triggering.
`BB:GPS:TRIG:SEQ ARET`
sets Armed_Retrigger mode, i.e. every trigger event causes signal generation to restart.
`BB:GPS:TRIG:EXEC`
executes a trigger, signal generation is started.
`BB:GPS:TRIG:ARM:EXEC`
signal generation is stopped.
`BB:GPS:TRIG:EXEC`
executes a trigger, signal generation is started again.

Usage: Event

<subsystem>:TRIGger:EXECute

Executes a trigger. The internal trigger source must be selected using the command `<subsystem>:TRIG:SOUR INT` and a trigger mode other than `AUTO` must be selected using the command `<subsystem>:TRIG:SEQ`.

Example:

```
BB:GPS:TRIG:SOUR INT
```

sets internal triggering.

```
BB:GPS:TRIG:SEQ ARET
```

sets "Armed_Retrigger" mode, i.e. every trigger event causes signal generation to restart.

```
BB:GPS:TRIG:EXEC
```

executes a trigger, signal generation is started.

```
BB:GPS:TRIG:ARM:EXEC
```

signal generation is stopped.

```
BB:GPS:TRIG:EXEC
```

executes a trigger, signal generation is started again.

Usage:

Event

<subsystem>:TRIGger:SOURce <Source>

Selects the trigger source.

Parameters:

<Source>

INTernal | EXTernal

INTernal

Triggering is executed by means of the Trigger command `SOURce:BB:GPS:TRIGger:EXECute` or `*TRG` in the case of remote control and by means of Execute Trigger in the case of manual operation.

EXTernal

Triggering is executed by means of the signal on the TRIGGER 1 connector.

Example:

```
BB:GPS:TRIG:SING
```

selects a trigger mode that requires a trigger.

```
BB:GPS:TRIG:SOUR EXT
```

sets external triggering via the TRIGGER connector.

<subsystem>:TRIGger:EXTernal:SYNChronize:OUTPut <Output>

(enabled for "Trigger Source" External)

Enables/disables output of the signal synchronous to the external trigger event.

See also "[Sync. Output to External Trigger](#)" on page 106 for a detailed description of the applications of this parameter.

Parameters:

<Output>

0 | 1 | OFF | ON

ON

The signal calculation starts simultaneously with the external trigger event but because of the instrument's processing time the first samples are cut off and no signal is outputted. After elapsing of the internal processing time, the output signal is synchronous to the trigger event.

OFF

The signal output begins after elapsing of the processing time and starts with sample 0, i.e. the complete signal is outputted.

*RST: ON

Example:

BB:GPS:TRIG:SOUR EXT

sets external triggering.

BB:GPS:TRIG:EXT:SYNC:OUTP ON

enables synchronous output to external trigger.

<subsystem>:TRIGger:OUTPut<ch>:DELay <Delay>

Defines the delay between the signal on the marker outputs and the start of the signal, expressed in terms of chips. Command :BB:GPS:TRIGger:OUTPut:DELay:FIXed can be used to restrict the range of values to the dynamic range, i.e. the range within which a delay of the marker signals can be set without restarting the marker and signal.

Parameters:

<Delay>

float

Range: 0 to $2^{32} - 1$ chips

Increment: 1 chip

*RST: 0

Example:

BB:GPS:TRIG:OUTP2:DEL 1600

sets a delay of 1600 chips for the signal on connector MARKER 2.

<subsystem>:TRIGger:OUTPut<ch>:DELay:MINimum?**<subsystem>:TRIGger:OUTPut<ch>:DELay:MAXimum?**

Queries the maximum marker delay for setting <subsystem>:TRIG:OUTP:DEL:FIX ON.

Return values:

<Maximum>

float

Range: 0 to max

Example: `BB:GPS:TRIG:OUTP:DEL:FIX ON`
 restricts the marker signal delay setting range to the dynamic range.

`BB:GPS:TRIG:OUTP:DEL:MAX?`
 queries the maximum of the dynamic range.

Response: 2000
 the maximum for the marker delay setting is 2000 chips.

Usage: Query only

<subsystem>:TRIGger:OUTPut:DELay:FIXed <Fixed>

Restricts the marker delay setting range to the dynamic range. In this range the delay can be set without restarting the marker and signal. If a delay is entered in setting ON but is outside this range, the maximum possible delay is set and an error message is generated.

Parameters:

<Fixed> 0 | 1 | OFF | ON
 *RST: 0

Example: `BB:GPS:TRIG:OUTP:DEL:FIX ON`
 restricts the marker signal delay setting range to the dynamic range.

<subsystem>:TRIGger[:EXTErnal<ch>]:DELay <Delay>

Specifies the trigger delay (expressed as a number of chips) for external triggering.

Parameters:

<Delay> float
 Range: 0 to 65535
 Increment: 0.01 chip
 *RST: 0.0 chips

Example: `BB:GPS:TRIG:SOUR EXT`
 sets an external trigger via the TRIGGER 1 connector.

`BB:GPS:TRIG:DEL 50`
 sets a delay of 50 chips for the trigger.

<subsystem>:TRIGger[:EXTErnal<ch>]:INHibit <Inhibit>

Specifies the number of chips by which a restart is to be inhibited following a trigger event. Applies only in the case of external triggering.

Parameters:

<Inhibit> integer
 Range: 0 to 67108863
 Increment: 1 chip
 *RST: 0

Example: `BB:GPS:TRIG:SOUR EXT`
 selects an external trigger via the TRIGGER 1 connector.
 `BB:GPS:TRIG:INH 200`
 sets a restart inhibit for 200 chips following a trigger event.

4.17 Marker Settings

This section lists the remote control commands, necessary to configure the markers.

`OUTPut<ch>`

The numeric suffix to `OUTPut` distinguishes between the available markers.

Only two markers are available for the R&S SMBV, i.e. the allowed values for the suffix are 1 or 2.

<code><subsystem>:TRIGger:OUTPut<ch>:MODE</code>	208
<code><subsystem>:TRIGger:OUTPut<ch>:ONTime</code>	209
<code><subsystem>:TRIGger:OUTPut<ch>:OFFTime</code>	209
<code><subsystem>:TRIGger:OUTPut<ch>:PATTern</code>	210
<code><subsystem>:TRIGger:OUTPut<ch>:PULSe:DIVider</code>	210
<code><subsystem>:TRIGger:OUTPut<ch>:PULSe:FREQuency</code>	210
<code><subsystem>:TRIGger:OUTPut<ch>:PULSe:WIDTh</code>	211

`<subsystem>:TRIGger:OUTPut<ch>:MODE <Mode>`

Defines the signal for the selected marker output.

Note: In instruments equipped with option R&S SMBV-K96, disabled `<subsystem>:UMGPS` on page 127 and enabled satellites constellation with more than 12 satellites, only one marker signal is available.

Parameters:

<Mode>

PULSe | PATtern | RATio | PPS | PP2S | TRIGger | DISabled | PPS10 | | REStart

PULSe

A pulsed marker signal is generated. The pulse frequency (= symbol rate/divider) is defined with the

<subsystem>:TRIG:OUTP:PULSe:DIVider command and can be queried with the

<subsystem>:TRIG:OUTP:PULSe:FREQuency? command.

PATtern

A marker signal is generated according to the user defined pattern (command <subsystem>:TRIGger:OUTPut:PATtern).

RATio

A marker signal corresponding to the Time Off / Time On specifications in the commands

<subsystem>:TRIGger:OUTPut:OFFT and

<subsystem>:TRIGger:OUTPut:ONT is generated.

PPS | PP2S | PPS10

A marker signal is generated for every start of second, every second second or respectively every tenth second (GPS time). The pulse width is defined with the

<subsystem>:TRIG:OUTP:PULSe:WIDTh command

TRIGger

A marker signal is generated only when a trigger event occurs. Then the signal is generated continuously. Every subsequent trigger event causes a restart.

DISabled

Generation of a marker signal is deactivated.

Restart

(R&S WinIQSIM2 only)

The signal is generated continuously. A trigger event causes a restart.

*RST: PPS

Example:

BB:GPS:TRIG:OUTP2:PATT #B000000011111111,15
sets a bit pattern.

BB:GPS:TRIG:OUTP1:MODE PATT

activates the marker signal according to a bit pattern on output MARKER 1.

<subsystem>:TRIGger:OUTPut<ch>:ONTime <OnTime>

<subsystem>:TRIGger:OUTPut<ch>:OFFTime <OffTime>

Sets the number of chips in a period (ON time + OFF time) during which the marker signal in setting <subsystem>:TRIGger:OUTPut:MODE RATio on the marker outputs is OFF.

Parameters:

<Offtime> float
 Range: 1 to $2^{24} - 1$ chips
 Increment: 1 chip
 *RST: 1 chip

Example:

BB:GPS:TRIG:OUTP2:OFFT 200
 sets an OFF time of 200 chips for marker signal 2.

<subsystem>:TRIGger:OUTPut<ch>:PATTern <Pattern>

Defines the bit pattern used to generate the marker signal in the setting
 <subsystem>:TRIGger:OUTPut:MODE PATTern. 0 is marker off, 1 is marker on.

Parameters:

<Pattern> 64 bit pattern
 Range: #B0,1 to #B111...1,64
 *RST: #B0,1

Example:

BB:GPS:TRIG:OUTP2:PATT #B000000011111111,15
 sets a bit pattern.
 BB:GPS:TRIG:OUTP2:MODE PATT
 activates the marker signal according to a bit pattern on output
 MARKER 2.

<subsystem>:TRIGger:OUTPut<ch>:PULSe:DIVider <Divider>

Sets the divider for Pulse marker mode (<subsystem>:TRIG:OUTP:MODE PULSe).
 The resulting pulse frequency is derived by dividing the chip rate (1.023 MHz) by the
 divider.

Parameters:

<Divider> integer
 Range: 2 to 1024
 Increment: 1
 *RST: 2

Example:

BB:GPS:TRIG:OUTP2:PULS:DIV 2
 sets the divider to 2 for the marker signal on output MARKER 2.
 BB:GPS:TRIG:OUTP2:FREQ?
 queries the resulting pulse frequency of the marker signal.
 Response: 511511.038
 the resulting pulse frequency is 511.511 kHz.

<subsystem>:TRIGger:OUTPut<ch>:PULSe:FREQUency?

Queries the pulse frequency of the pulsed marker signal in the setting
 <subsystem>:TRIGger:OUTPut:MODE PULSe. The pulse frequency is derived by
 dividing the symbol rate by the divider.

Return values:

<Frequency> float
Range: 0 to max

Example:

BB:GPS:TRIG:OUTP2:PULS:DIV 2
sets the divider for the marker signal on output MARKER 2 to the value 2.
BB:GPS:TRIG:OUTP2:MODE PULS
enables the pulsed marker signal.
BB:GPS:TRIG:OUTP2:PULS:FREQ?
queries the pulse frequency of the marker signal.
Response: 511511.038
the resulting pulse frequency is 511.511 kHz.

Usage: Query only

<subsystem>:TRIGger:OUTPut<ch>:PULSe:WIDTh <Width>

Sets the Pulse Width for 1PPS and 1PP2S marker mode
(<subsystem>:TRIG:OUTP:MODE PPS | PP2S).

Parameters:

<Width> integer
Range: 1 to 800
*RST: 1

Example:

BB:GPS:TRIG:OUTP2:MODE PPS
enables the 1PPS marker signal.
BB:GPS:TRIG:OUTP1:PULS:WIDT 2
sets the pulse width for the marker signal on output MARKER 2 to the value 2.

4.18 Clock Settings

This section lists the remote control commands, necessary to configure the clock.

<subsystem>:CLOCK:MODE.....	211
<subsystem>:CLOCK:MULTiplier.....	212
<subsystem>:CLOCK:SOURce.....	212
<subsystem>:CLOCK:SYNChronization:EXECute.....	213
<subsystem>:CLOCK:SYNChronization:MODE.....	213

<subsystem>:CLOCK:MODE <Mode>

Enters the type of externally supplied clock (<subsystem>:CLOCK:SOURce EXTERNAL).

When MCHip is used, a multiple of the chip clock is supplied via the CLOCK connector and the chip clock is derived internally from this. The multiplier is entered with the command <subsystem>:CLOCK:MULTiplier.

Parameters:

<Mode> CHIP | MCHip
 *RST: CHIP

Example:

BB:GPS:CLOC:MODE CHIP
 selects clock type "Chip", i.e. the supplied clock is a chip clock.

<subsystem>:CLOCK:MULTIplier <Multiplier>

Specifies the multiplier for clock type "Multiplied" (<subsystem>:CLOCK:MODE MCHip) in the case of an external clock source.

Parameters:

<Multiplier> float
 Range: 1 to 64
 Increment: 1
 *RST: 4

Example:

BB:GPS:CLOC:SOUR EXT
 selects the external clock source. The clock is supplied via the CLOCK connector.
 BB:GPS:CLOC:MODE MCH
 selects clock type "Multiplied", i.e. the supplied clock has a rate which is a multiple of the chip rate.
 BB:GPS:CLOC:MULT 12
 the multiplier for the external clock rate is 12.

<subsystem>:CLOCK:SOURce <Source>

Selects the clock source.

For two-path instruments, selecting EXTERNAL is only possible for path A, since the external clock source is permanently allocated to path A.

Parameters:

<Source> INTERNAL | EXTERNAL | AINTERNAL

INTERNAL

The internal clock reference is used to generate the chip clock (1.023 MHz).

EXTERNAL

The external clock reference is supplied to the CLOCK connector.

*RST: INTERNAL

Example:

BB:GPS:CLOC:SOUR EXT
 selects an external clock reference. The clock is supplied via the CLOCK connector.
 BB:GPS:CLOC:MODE CHIP
 specifies that a chip clock is supplied via the CLOCK connector.

<subsystem>:CLOCK:SYNChronization:EXECute

Performs automatically adjustment of the instrument's settings required for the selected synchronization mode.

Usage: Event

<subsystem>:CLOCK:SYNChronization:MODE <Mode>

Selects the synchronization mode.

This parameter is used to enable generation of very precise synchronous signals from several connected R&S SMBVs.

Note: If several instruments are connected, the connecting cables from the master instrument to the slave and between each two consecutive slave instruments must have the same length and type. Avoid unnecessary cable length and branching points.

Parameters:

<Mode> NONE | MASTer | SLAVe

NONE

The instrument is working in stand-alone mode.

MASTer

The instrument synchronizes all connected instruments, including the trigger and reference clock signals.

SLAVe

The instrument receives the synchronisation and reference clock signal from another instrument working in a master mode.

*RST: NONE

Example:

```
BB:GPS:CLOC:SYNC:MODE MAST
```

Defines the current instrument as the master for synchronization of the connected instruments

A Movement Files

Three movement file formats are supported, two [Waypoint/Vector file's formats](#) and the [NMEA file format](#).

A.1 Waypoint/Vector file's formats

Two `.txt` formats can be used for the waypoint file:

- The first format is a list of coordinates (longitude, latitude, altitude) and a respective resolution in milliseconds, as shown for the case of 3GPP Performance Test Scenario#3 "Melbourne" (WGS 84 geodetic coordinates)
The resolution command at the beginning of the format specifies the sampling rate to be used for the WGS-84 geodetic coordinates list. The resolution gives the time (in ms) between two consecutive waypoints.

```
RESOLUTION: 50
144.966666334601,-37.8166633061788,100.00000009313
144.966662392613,-37.8166632247233,100.00000039116
144.966658453002,-37.8166630889914,100.0000008475
144.966654516955,-37.8166628990241,100.000000149943
144.966650585658,-37.8166626548785,100.000000235625
144.966646660296,-37.8166623566284,100.000000339001
144.966642742053,-37.8166620043635,100.000000461936
144.966638832109,-37.81666159819,100.000000603497
144.966634931642,-37.8166611382304,100.000000762753
144.96663104183,-37.8166606246233,100.000000941567
144.966627163843,-37.8166600575235,100.000001138076
144.96662329885,-37.8166594371019,100.000001354143
144.966619448018,-37.8166587635456,100.000001588836
144.966615612505,-37.8166580370574,100.000001840293
144.966611793469,-37.8166572578565,100.00000211224
144.96660799206,-37.8166564261776,100.00000240095
144.966574759635,-37.8166466260761,100.00000580959
etc.
```

- The second format uses a script containing the commands defined in the following table:

Command	Description
REFERENCE: lon, Lat, alt	Specifies the Cartesian Reference of the ENU coordinates system. Given as a geodetic WGS-84 point (longitude, Latitude, Altitude).
START: E ,N, U, Velocity	Start location i.e., initial "current location" in the ENU Cartesian coordinate of center "REFERENCE". East, North and UP (ENU) coordinates are then provided (m). The last argument is the start velocity in (m/s).

Command	Description
ARC: E, N, Angle	Specifies a 2-Dimensional ARC (East, North) with the first two arguments representing the center of the ARC (m) in the Cartesian basis. The last argument specifies the angle in degrees (°) of the Arc Starting the "current location". Angle sign is significant since it indicates positive direction (against clock movement) or negative direction (same as clock movement). The end edge of the arc represents the new "current location". Velocity doesn't change when using an ARC command.
LINE: ΔE, ΔN, Acceleration	Specifies a 2-Dimensional Line starting the "current location" as the first edge and (Current loc E + ΔE, Current loc N + ΔN) as the second edge (m). Constant acceleration/deceleration can be specified in the last argument e.g., (0 means constant velocity). Unit for acceleration is (m/s ²). The second edge is again used as the "current location" for the next command. The speed at this second edge is also used as the start speed for the next command.
STAY: Time	Stay at the current location for Time period (ms).

A.1.1 Example of Waypoint File

This example explains a waypoint file in the second format for the case of 3GPP Performance Test Scenario#3 "Melbourne", as described in 3GPP 34.108 v.8.0.0, 3GPP 34.171 v.7.0.1.

The GPS signals simulate the GPS-receiver moving on a rectangular trajectory of 940m by 1 440m with rounded corners defined in [table 1-1](#) and [figure 1-1](#).

The initial reference is first defined followed by acceleration to final speed of 100 km/h in 250 m.

The UE then maintains the speed for 400 m. This is followed by deceleration to final speed of 25 km/h in 250 m. The UE then turn 90 degrees with turning radius of 20 m at 25 km/h. This is followed by acceleration to final speed of 100 km/h in 250 m.

The sequence is repeated to complete the rectangle.

Table 1-1: Trajectory Parameters for Moving Scenario and Periodic Update Performance test case

Parameter	Distance (m)	Speed (km/h)
$l_{11}, l_{15}, l_{21}, l_{25}$	20	25
$l_{12}, l_{14}, l_{22}, l_{24}$	250	25 to 100 and 100 to 25
l_{13}	400	100
l_{23}	900	100


```
LINE: 0, 250, -1.44675925925925926  
ARC: 0, 920, -90  
LINE: 250, 0, 1.44675925925925926  
LINE: 900, 0, 0  
LINE: 250, 0, -1.44675925925925926  
ARC: 1400, 920, -90  
LINE: 0, -250, 1.44675925925925926  
LINE: 0, -400, 0  
LINE: 0, -250, -1.44675925925925926  
ARC: 1400, 20, -90  
LINE: -250, 0, 1.44675925925925926  
LINE: -900, 0, 0  
LINE: -250, 0, -1.44675925925925926  
%%End of Trajectory description
```

A.2 NMEA Files as Source for Movement Information

The NMEA movement information (receiver-fix location) extracted from a standard NMEA file can be used as a source for the generation of the movement file of interest.

Refer to [chapter C, "NMEA Scenarios"](#), on page 221 for detailed description of the NMEA file format.

B RINEX Files

The RINEX file format consists of three ASCII file types: observation data file, navigation message file and meteorological data file. The navigation RINEX files comprises the Ephemeris information of all visible satellites at a control station or a commercial receiver.

Each file type consists of a header section and a data section. The header section contains global information for the entire file and is placed at the beginning of the file. The format of the data records of the RINEX navigation message files may contain navigation messages of more than one satellite system (GPS, GLONASS, Galileo, etc.). See [RINEX Format Description](#) for description of the RINEX file format.



RINEX Navigation Files can be downloaded from http://cddis.gsfc.nasa.gov/gnss_data-sum.html#brdc.

B.1 RINEX Format Description

Records marked with * are optional

Table 2-1: Navigation message file - header section description

	HEADER LABEL (Columns 61-80)	DESCRIPTION	FORMAT
	RINEX VERSION / TYPE	<ul style="list-style-type: none"> Format version (2) File type ('N' for Navigation data) 	I6,14X, A1,19X
	PGM / RUN BY / DATE	<ul style="list-style-type: none"> Name of program creating current file Name of agency creating current file Date of file creation 	A20, A20 A20
*	COMMENT	Comment line(s)	A60
*	ION ALPHA	Ionosphere parameters A0-A3 of almanac (page 18 of subframe 4)	2X,4D12.4
*	ION BETA	Ionosphere parameters B0-B3 of almanac	2X,4D12.4
*	DELTA-UTC: A0,A1,T,W	Almanac parameters to compute time in UTC (page 18 of subframe 4) A0,A1: terms of polynomial T : reference time for UTC data W : UTC reference week number. Continuous number, not mod(1024)!	3X,2D19.12, 2I9
*	LEAP SECONDS	Delta time due to leap seconds	I6
	END OF HEADER	Last record in the header section.	60X

Table 2-2: Navigation message file - data record description

	HEADER LABEL (Columns 61-80)	DESCRIPTION	FORMAT
	PRN / EPOCH / SV CLK	<ul style="list-style-type: none"> Satellite PRN number Epoch: Toc - Time of Clock <ul style="list-style-type: none"> year (2 digits) month day hour minute second SV clock bias (seconds) SV clock drift (sec/sec) SV clock drift rate (sec/sec²) 	I2, 5I3, F5.1, 3D19.12
	BROADCAST ORBIT - 1	<ul style="list-style-type: none"> IODE Issue of Data, Ephemeris Crs (meters) Delta n (radians/sec) M0 (radians) 	3X,4D19.12
	BROADCAST ORBIT - 2	<ul style="list-style-type: none"> Cuc (radians) e Eccentricity Cus (radians) sqrt(A) (sqrt(m)) 	3X,4D19.12
	BROADCAST ORBIT - 3	<ul style="list-style-type: none"> Toe Time of Ephemeris (sec of GPS week) Cic (radians) OMEGA (radians) CIS (radians) 	3X,4D19.12
	BROADCAST ORBIT - 4	<ul style="list-style-type: none"> i0 (radians) Crc (meters) omega (radians) OMEGA DOT (radians/sec) 	3X,4D19.12
	BROADCAST ORBIT - 5	<ul style="list-style-type: none"> IDOT (radians/sec) Codes on L2 channel GPS Week # (to go with TOE) Continuous number, not mod(1024)! L2 P data flag 	3X,4D19.12
	BROADCAST ORBIT - 6	<ul style="list-style-type: none"> SV accuracy (meters) SV health (MSB only) TGD (seconds) IODC Issue of Data, Clock 	3X,4D19.12
	BROADCAST ORBIT - 7	<ul style="list-style-type: none"> Transmission time of message (sec of GPS week, derived e.g. from Z-count in Hand Over Word (HOW)) spare spare spare 	3X,4D19.12

B.2 Example of a RINEX File

The following part of a script has the ephemeris info of satellites 4 and 9 at toc = toe = 352800.

```
2.10          N: GPS NAV DATA          RINEX VERSION / TYPE
teqc 2002Mar14  Lisa McCormick  20090501 01:40:41UTCPGM / RUN BY / DATE
```

Example of a RINEX File

```
Solaris 2.7|Ultra 2|cc SC5.0|=+-*Sparc COMMENT
rnw Dataflow Processing 04/30/2009 00:00:21 COMMENT
END OF HEADER

4 09 4 30 2 0 0.0-7.157493382690D-05-1.523403625470D-11 0.000000000000D+00
5.100000000000D+01 9.125000000000D+00 5.024495004670D-09-3.085066632770D+00
3.930181264880D-07 8.587007410820D-03 7.828697562220D-06 5.153723627090D+03
3.528000000000D+05 3.725290298460D-09 1.098217239560D-01-1.024454832080D-07
9.410577584670D-01 2.186875000000D+02 4.847291251310D-01-8.071407635100D-09
-3.571577341960D-10 1.000000000000D+00 1.529000000000D+03 0.000000000000D+00
2.400000000000D+00 0.000000000000D+00-6.053596735000D-09 5.100000000000D+01
3.456060000000D+05 4.000000000000D+00

9 09 4 30 2 0 0.0 5.332380533220D-05 1.932676241270D-12 0.000000000000D+00
1.070000000000D+02-7.959375000000D+01 4.243748197720D-09-2.353512095310D+00
-4.012137651440D-06 2.042865683320D-02 3.149732947350D-06 5.153640602110D+03
3.528000000000D+05 2.738088369370D-07-3.071164751940D+00 9.499490261080D-08
9.762633443270D-01 3.201250000000D+02 1.469759572200D+00-7.773895242510D-09
1.046472161190D-10 1.000000000000D+00 1.529000000000D+03 0.000000000000D+00
2.400000000000D+00 0.000000000000D+00-5.587935447690D-09 1.070000000000D+02
3.456060000000D+05 4.000000000000D+00
```

C NMEA Scenarios

The National Marine Electronic Association (NMEA) is a broadcasting standard supported by all navigation receivers. The NMEA files comprise information about common parameters related to the satellite constellation, navigation parameters, time, receiver location and dynamics. The [table 3-1](#) defines the starting acronym for a NMEA command of a specific navigation standard. In the moment this firmware is released, the Galileo NMEA acronym has not been defined yet.

Table 3-1: Overview of the starting acronyms for the NMEA command

ID	Meaning
AG	Autopilot - General
AP	Autopilot - Magnetic
CC	Computer - Programmed Calculator (outdated)
CD	Communications - Digital Selective Calling (DSC)
CM	Computer - Memory Data (outdated)
CS	Communications - Satellite
CT	Communications - Radio-Telephone (MF/HF)
CV	Communications - Radio-Telephone (VHF)
CX	Communications - Scanning Receiver
DE	DECCA Navigation
DF	Direction Finder
EP	Emergency Position Indicating Beacon (EPIRB)
ER	Engine Room Monitoring Systems
GP	Global Positioning System (GPS)
GL	GLONASS
HC	Heading - Magnetic Compass
HE	Heading - North Seeking Gyro
HN	Heading - Non North Seeking Gyro
II	Integrated Instrumentation
IN	Integrated Navigation
LA	Loran A
LC	Loran C
MP	Microwave Positioning System (outdated)
OM	OMEGA Navigation System

Example of NMEA File

```
$GPVTG,,T,,M,0.000,N,0.000,K,A*23
$GPGGA,215810.00,3540.00066,N,13944.99611,E,1,04,1.61,6.8,M,39.4,M,,*5E
$GPGSA,A,3,06,09,04,10,,,,,,,,,2.47,1.61,1.87*01
$GPGSV,4,1,14,29,48,312,,26,47,312,,06,35,302,47,09,18,238,47*71
$GPGSV,4,2,14,27,47,312,,13,50,118,,04,72,181,47,30,48,312,*76
$GPGSV,4,3,14,14,39,070,,10,12,050,47,31,48,312,,07,64,349,*72
$GPGSV,4,4,14,25,47,312,,28,48,312,*7E
$GPGLL,3540.00066,N,13944.99611,E,215810.00,A,A*69
$GPZDA,215810.00,28,04,2023,00,00*64
$GPRMC,215811.00,A,3540.00066,N,13944.99611,E,0.000,,280423,,A*7E
```

List of Commands

<subsystem>:ADGeneration:ACQuisition:CREate.....	188
<subsystem>:ADGeneration:ALManac:CREate.....	188
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DECimal.....	184
<subsystem>:ADGeneration:GPS:LOCation:COORdinateS:DMS.....	184
<subsystem>:ADGeneration:GPS:LOCation:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:LOCation:URADius.....	185
<subsystem>:ADGeneration:GPS:SVID:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:SVID<ch>:ACQuisition:BLOCK.....	181
<subsystem>:ADGeneration:GPS:SVID<ch>:SAData.....	182
<subsystem>:ADGeneration:GPS:SVID<ch>:STATe.....	183
<subsystem>:ADGeneration:GPS:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:TOAData:DATE.....	186
<subsystem>:ADGeneration:GPS:TOAData:DURation.....	187
<subsystem>:ADGeneration:GPS:TOAData:RESolution.....	187
<subsystem>:ADGeneration:GPS:TOAData:SYNChronize.....	183
<subsystem>:ADGeneration:GPS:TOAData:TBASis.....	186
<subsystem>:ADGeneration:GPS:TOAData:TIME.....	186
<subsystem>:ADGeneration:GPS:TOAData:TOWeek.....	187
<subsystem>:ADGeneration:GPS:TOAData:WNUMBER.....	188
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<subsystem>:ADGeneration:MODE.....	183
<subsystem>:ADGeneration:NAVigation:CREate.....	189
<subsystem>:ADGeneration:UTC:CREate.....	189
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<subsystem>:ATMospheric:GALileo:IONospheric:SF<ch>.....	179
<subsystem>:ATMospheric:GALileo:TROPospheric:MODEl.....	178
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<subsystem>:CLOCK:SOURce.....	212
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<subsystem>:CLOCK:SYNChronization:MODE.....	213
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<subsystem>:GOConstellation.....	145
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<subsystem>:HYBRid:GPS[:STATe].....	127
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<subsystem>:LOCation:WAYPointS:ROMode.....	121
<subsystem>:LOCation[:SElect].....	120
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<subsystem>:NAVigation:ALManac:GALileo:TOAPplicability:WNUMber.....	132
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<subsystem>:NAVigation:ALManac:GPS:TOAPplicability:WNUMber.....	132
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<subsystem>:NAVigation:SIMulation:WNUMber.....	126

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<subsystem>:SVID:GPS:LIST.....	134
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<subsystem>:SVID<ch>:<GNSS>:NMESsage[:PAGE<us>]:EPHemeris:OMEGa.....	166
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